Series 8500 FDMS®

Filter Dynamics Measurement System

Operating Manual

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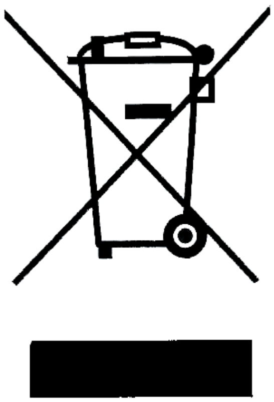

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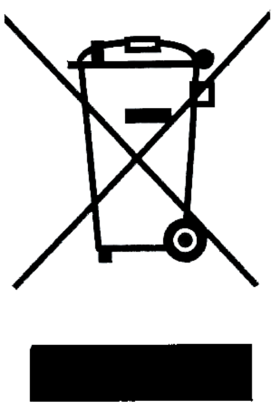

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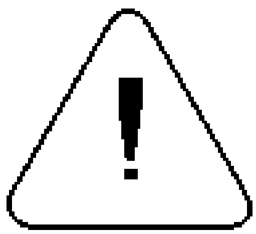
Equipment Ratings

The following information can be used to determine the power service requirements for the Series 8500 FDMS Monitor (not including the sampling pump):

Line Voltage
115 V ~ 60 Hz 1.0 Amp
230 V ~ 50 Hz 0.5 Amp

IMPORTANT: Disconnect the power cord from the power source (output) while servicing the instrument to prevent electrical hazard.



Environmental Ranges — The instrument and its sample pump must be installed in a weather-sheltered location that is heated in the winter and air conditioned in the summer.

NOTE: There may be hazardous line (wire) accessible inside the enclosure.

Electrical and Safety Conformity

This product has been designed to be in compliance with the following U.S., Canadian, and European Safety Standards:

UL Standard 3101-1
CAN/CSA C22.2 NO. 1010.1
EN61010-1:1995

Thermo Fisher Scientific certifies that this product operates in compliance with the EC Directive 89/336/EEC in reference to electrical emissions and immunity. Specifically, the equipment meets the requirements of EN61326:1997 (Emissions & Immunity).

Section Revision List

As Thermo Scientific instrumentation changes, so do our operating and service manuals. However, these changes may affect only one aspect of an instrument, while leaving the instrument as a whole unchanged. To explain these individual changes to our customers, the company will update only those sections of its operating and service manuals that are affected by the instrument updates or improvements. As each manual section changes, so does its revision number, which is located at the top, right-hand corner of each page of each section.

To help our customers keep track of the changes to the Series 8500 FDMS Filter Dynamics Measurement System and its operating manual, following is a list of the manual sections with their respective revision numbers:

Section Number and Description	*Revision Number*
Section 1: Introduction	C.000
Section 2: Hardware Installation	C.000
Section 3: Sample Preparation	C.000
Section 4: Software Overview	C.000
Section 5: Basic Operation	C.000
Section 6: Software Setup	C.000
Section 7: Status Codes	C.000
Section 8: Viewing Stored Data	C.000
Section 9: Data Input and Output	C.000
Section 10: Using RPComm	C.000
Section 11: Password Protection	C.000
Section 12: Routine Maintenance and Verification Procedures	C.000
Section 13: Resetting the Monitor	C.000
Appendix A: Overview of Software Screens	C.000
Appendix B: Program Register Codes	C.000

Section Revision List (continued)

Section Number and Description	*Revision Number*
Appendix C: Two-Way Serial Communication	C.000
Appendix D: Installing New Software	C.001
Appendix E: Consumables and Parts	C.001
Appendix F: Filter Log	C.000
Appendix G: Inlet Maintenance	C.000
Appendix H: Modem Communications	C.000
Appendix I: ASCII Codes	C.000
Appendix J: TEOMCOMM Software	C.000
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Section 1: Introduction

The Series 8500 FDMS™ Filter Dynamics Measurement System (Figure 1-1) incorporates the patented Tapered Element Oscillating Microbalance (TEOM®) technology to measure particulate matter mass concentrations continuously. The Series 8500 FDMS Monitor consists of three basic components: the 8500 module (Figure 1-1), TEOM Series 1400a sensor unit (containing the sample inlet and mass transducer) (Figure 1-2), and the TEOM Series 1400a control unit (containing the operator terminal and control electronics) (Figure 1-2).

Figure 1-1. Series 8500C FDMS module.

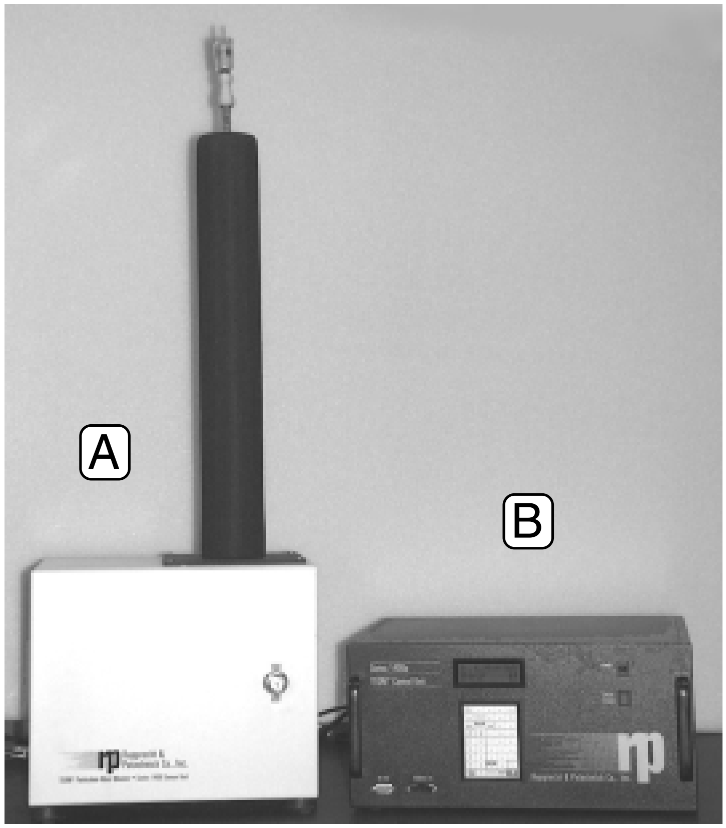


Figure 1-2. TEOM Series 1400a sensor unit (A) and control unit (B).

The Series 8500 FDMS Monitor can be configured with a variety of sample inlets to measure PM-10, PM-2.5 or PM-1 concentrations. The microprocessor-based unit accommodates all siting requirements and provides internal data storage and analog and serial data input/output capabilities.

The Series 8500 FDMS™ Filter Dynamics Measurement System provides a representative determination of the particulate matter (PM) concentration as it exists in the ambient air. The FDMS unit automatically generates mass concentration measurements (μg/m^3) that account for both nonvolatile and volatile PM components.

The system is composed of a TEOM Series 1400a Ambient Particulate Monitor loaded with Series FDMS 8500 module operating software and an FDMS kit. For current users of TEOM Series 1400a (Revision B) monitors, the FDMS kit can be added to an existing installation (Section 2).

The FDMS system is composed of two major subsystems:

- The sampling system consists of a size-selective inlet, flow splitter, air chiller/dryer, and a switching valve that is used to direct the sample flow through the 8500 module.

- The analysis and control system is made up of a sample filter that is part of the TEOM microbalance, humidity sensors for the main and bypass flows, and a control unit containing flow controllers and data management hardware.

The mass calibration verification kit allows users to confirm FDMS mass measurement accuracy using an NIST-traceable mass transfer standard.

The Streamline FTS Flow Transfer Standard uses differential pressure across a specially constructed orifice to determine flow rates. The unit is calibrated on a bench developed in a collaborative effort between the manufacturer, Chinook Engineering LLC, and NIST (National Institute of Standards and Technology).

Based upon the adjusted change in the filter sample mass and sampled volume, the FDMS unit computes a one-hour running average of the PM mass concentration. The instrument updates this value every six minutes based upon the newest information. The unit calculates the mass concentration (MC) based on the slope of the frequency (mass) that is measured during each base/reference measurement period (six minutes).

Based upon mass concentration (MC) measurements obtained during the base and reference periods, the FDMS system updates a one-hour average of the following results every six minutes (Section 7):

- Base mass concentration (Base MC) = PM concentration of the particle-laden sample stream (comparable to the Sample Equilibration System at 30° C).
- Reference mass concentration (Ref MC) = PM concentration of the particle-free sample stream, after passing through the purge filter.
- Mass concentration (MC) = Base mass concentration (Base MC) adjusted by the reference mass concentration (Ref MC) — Base MC (usually positive) minus Ref MC (negative when mass volatilizes from the filter).

For example, the unit draws a base flow for six minutes and measures a mass concentration of “5” (Base MC = 5). Then the unit draws a reference flow for six minutes and measures a mass concentration of “-1” (Ref MC = -1).

Therefore, the mass concentration is “6,” where:

MC = Base MC - Ref MC

6 = 5 - (-1)

1.1. Advanced Features

The Series 8500 FDMS Monitor contains the following features:

- Self-referencing real-time TEOM mass monitor
- Sample Equilibration System (SES) used to dry and condition the sample stream
- Active volumetric (ActiVol) flow control incorporating mass flow controllers, sensors for ambient temperature and pressure, and the control logic for maintaining a constant volumetric flow rate
- Characterized size-selective inlet systems operating at 1 m^3/h (16.7 l/min) for PM-10, PM-2.5 and PM-1 sampling
- TEOM inertial microbalance system providing a consistent, true mass reading of the collection filter mass
- Mass transducer design provides improved mass resolution for short-term measurements
- Incorporates "AB" technology for enhanced measurement stability for mobile installations
- Filter-based, direct mass monitoring using TEOM technology. The instrumentation contains no radioactive components and has a 2-year warranty.
- Continuous dust monitor with U.S. EPA approval (EQPM-1090-079) that complies with the California ARB 1-hour acceptance criteria for mass concentration precision.
- Mass and time resolution (mass transducer minimum detection limit of 0.06 µg). The instrument has a precision of ±2.5 µg/m³ for 1-hour averages.
- Available with a choice of sample inlets for PM-10, PM-2.5, or PM-1 measurements
- Sample filters can be analyzed after exposure for heavy metals using standard laboratory techniques such as AA or ICAP.

- Viewing and entry of instrument parameters are made possible by a menu-driven user interface. Keypads are available in English, Spanish and German.

- Internal data logging of up to 40 weeks with one data record stored every hour. Each record may contain up to eight user-selectable variables.

- Two levels of password protection – low and high lock. These can be used to restrict access to instrument functions.

- Advanced RS232 support. This allows users to retrieve real-time and stored information and change instrument parameters, both remotely and at the sampling location.

- Three real-time analog outputs allow straightforward connections to data loggers or chart recorders. These outputs can be configured as 0-1, 0-2, 0-5 or 0-10 VDC. The monitor also contains two user-definable, contact closure circuits.

1.2. Overview of Manual

This manual describes the installation and operation of the Series 8500 FDMS Monitor. Follow the setup instructions contained in Sections 2 and 3 before applying power to the unit in the manner described in Section 5.

This manual is divided into 13 sections and 10 appendices that discuss different topics. Sections 1 and 2 explain the system hardware, while later sections describe the system's software and the setup and operation of the monitor. The following list provides an overview of the topics handled in each section of the manual:

Section 1: Introduction
This section provides an overview of the Series 8500 FDMS Monitor, as well as the theory of operation of the instrument's mass transducer.

Section 2: Hardware Installation
This section describes how to set up the system's hardware.

Section 3: Sample Preparation
A TEOM and 47 mm filter must be installed in the system before the unit is turned on. This section explains the steps required to install and exchange these filters.

Section 4: Software Overview
This section describes the operation of the Series 8500 FDMS Monitor, including viewing system data on the four-line display and changing instrument operating parameters.

Section 5: Basic Operation
This section provides brief instructions on how to turn on the instrument and initiate a sampling run. It also explains how to download data and how to perform an audit of the instrument.

Section 6: Software Setup
This section explains how to set up the instrument's software to run a sample.

Section 7: Status Codes
This section explains the monitor's status code information and screens.

Section 8: Viewing Stored Data
This section explains how to view the data stored in the Series 8500 FDMS Monitor.

Section 9: Data Input and Output
This section explains how to use the monitor's two user-definable contact closure circuits and three analog outputs. This section also explains how to download data through the RS232 port to a serial printer, personal computer (PC) and other data capture devices, such as a data logger.

Section 10: Using RPComm
RPComm is a communications software package for Windows operating systems that provides interactive remote communications with the instrumentation. This section describes how to set up a Series 8500 FDMS Monitor for direct communications with a personal computer and how to use RPComm.

Section 11: Password Protection
This section explains how to set and remove the Series 8500 FDMS Monitor's password protection.

Section 12: Routine Maintenance and Verification Procedures
This section describes the routine maintenance and verification procedures for the Series 8500 FDMS Monitor.

Section 13: Resetting The Unit
This section explains how to reset the Series 8500 FDMS Monitor.

Appendix A: Overview of Software Screens
This appendix provides an overview of the screens that appear on the Series 8500 FDMS Monitor, and the RPComm and TEOMCOMM software applications.

Appendix B: Program Register Codes
This appendix lists the code assignments for system variables (program register codes (PRCs)) used to define the operation of the instrument.

Appendix C: Two-Way Serial Communication
This appendix describes the two-way RS232 protocols used to exchange information between the Series 8500 FDMS Monitor and a computer or data logger.

Appendix D: Installing New Software
This appendix explains how to install new system software into the Series 8500 FDMS Monitor. This appendix also explains how to obtain and load RPComm onto your personal computer (PC).

Appendix E: Consumables and Parts
This appendix lists the consumables and spare parts used in the Series 8500 FDMS Monitor.

Appendix F: Filter Log
This appendix contains a filter log to track all readings associated with each exposed filter.

Appendix G: Inlet Maintenance
This appendix contains maintenance procedures for the PM-10 inlet, the modified PM-10 inlet, the sharp cut cyclone (SCC) PM-1 and PM-2.5 inlets.

Appendix H: Modem Communications
This appendix describes how to connect the Series 8500 FDMS Monitor to a modem for offsite communications and how to set up a serial switching device for use with multiple instruments.

Appendix I: ASCII Codes
This appendix contains a list of the principal ASCII codes that may be used for setting up the instrument's RS232 communications protocol.

Appendix J: TEOMCOMM Software
This appendix describes the screens and operation of the TEOMCOMM software program.

Appendix K: Outdoor Enclosure
This appendix describes how to install the Series 8500 FDMS Monitor into the outdoor enclosure.

Appendix L: Series 8500 Schematics
This appendix includes the interconnect diagrams of the Series 8500

1.3. Application Range

The Series 8500 FDMS Monitor is a real-time device used for measuring the particulate matter mass concentration of particulate matter smaller than 10 µm diameter in outdoor and indoor ambient air.

TEOM instruments are the only filter-based mass monitors that measure the mass of particulate matter suspended in gas streams in real time. This is made possible through the use of an inertial mass transducer patented in the U.S. and internationally by Thermo Electron Corporation.

The monitor is ideally suited for applications demanding real-time ambient air particulate matter monitoring in outdoor, indoor or industrial settings. It calculates mass concentration, mass rate and the total mass accumulation on the TEOM filter under the following conditions:

Flow rate through sample inlet	16.7 l/min (1 m^3/hr)
Main flow rate	3 l/min
Temperature of sample stream	30º C
Particulate matter concentration	less than 5 µg/m^3 to several g/m^3

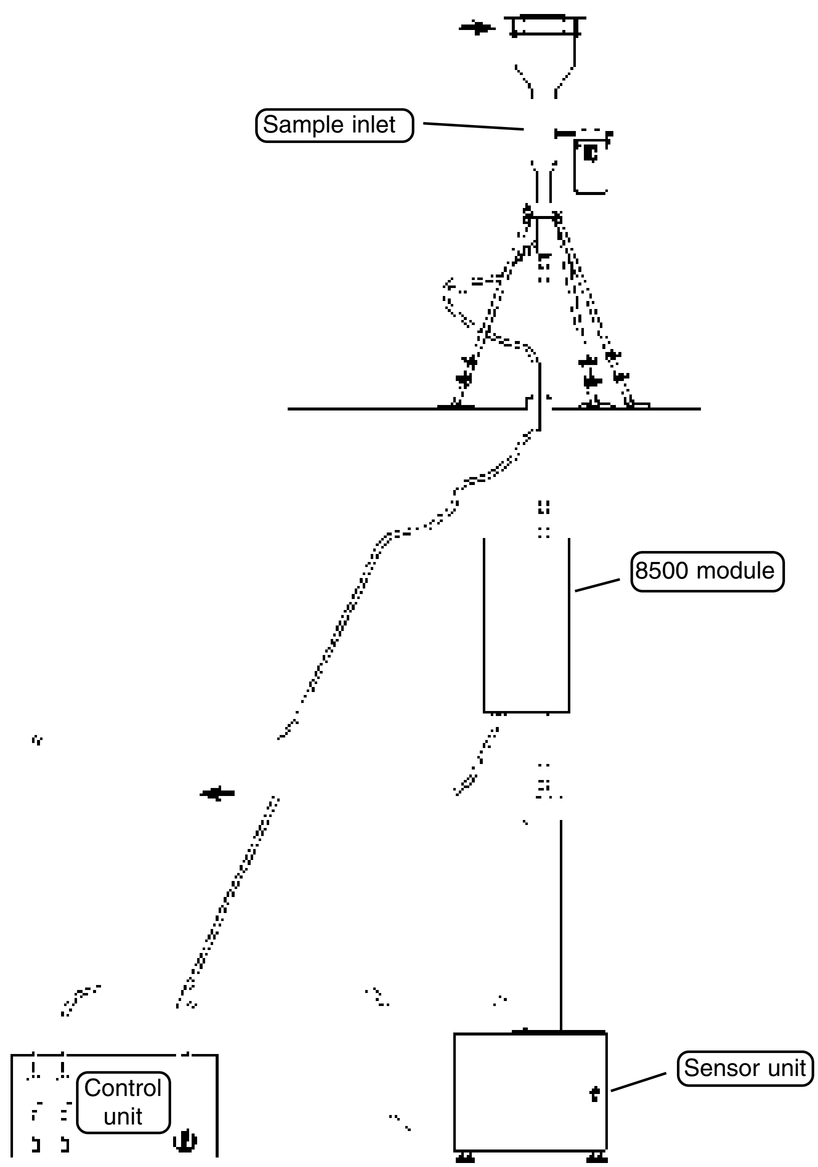
The ambient temperature sensor can measure temperatures ranging from -25º to 105º C, with an accuracy of ±2º C. The ambient pressure sensor is rated from 0.68 to 1.09 atm, and is specified to have a maximum error of 1.5% in the temperature range of 0º to 85º C. The Series 8500 FDMS Monitor smooths both the average temperature and average pressure over a period of approximately 15 seconds.

The Series 8500 FDMS Monitor uses the PM-10 inlet to perform a 10 µm particle size cutoff. Other size-selective inlets are available for PM-2.5 and PM-1 monitoring (Section 2).

1.4. General System Configuration

The Series 8500 FDMS Monitor is composed of three major components (Figure 1-4): the TEOM Series 1400a sensor unit, TEOM Series 1400a control unit, and the 8500 module. The user enters the system parameters into the control unit with the keypad, that is located on the front of the unit. Additionally, the system is furnished with software for personal computers to allow the user to view the operation of the instrument in real time, and to allow the user to enter system values directly from the PC. The instrument does not require a dedicated computer to function in the field.

Figure 1-4. Schematic diagram of a typical installation.



The sensor unit contains the mass measurement hardware that continuously monitors the accumulated mass on the system's exchangeable TEOM filter. By maintaining a flow rate of 3 l/min through the instrument and measuring the total mass accumulated on the TEOM filter, the device can calculate the mass concentration of the sample stream in near real-time.

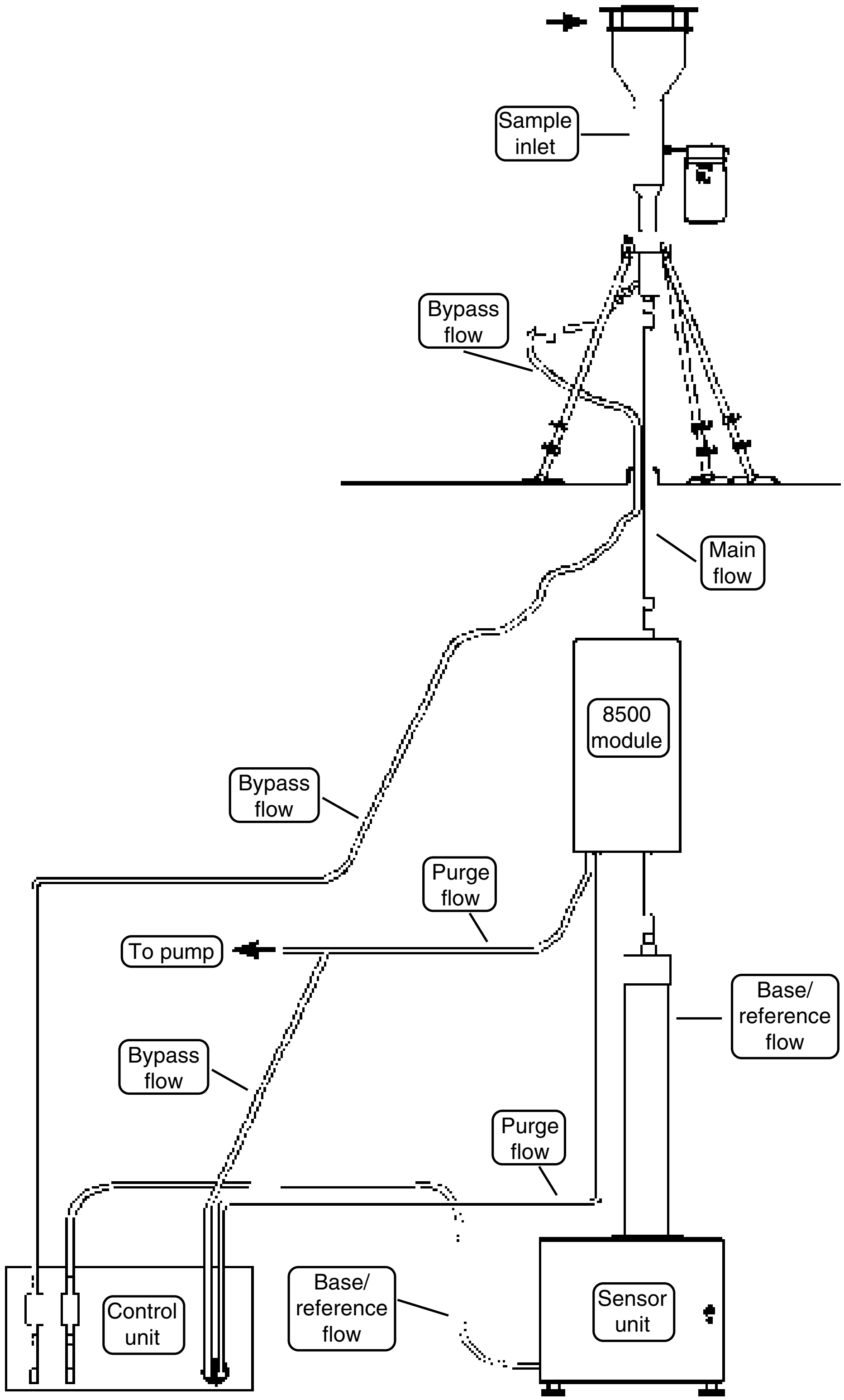
The control unit houses an industrially hardened microprocessor system, flow control hardware, a gauge to determine filter lifetime, transformers and power supplies.

1.5. Theory of Operation

The Series 8500 FDMS Monitor is a true “gravimetric” instrument that draws ambient air through a filter at a constant flow rate, continuously weighing the filter and calculating near real-time mass concentrations. In addition, the instrument computes the 1-hour, 8-hour, 12-hour and 24-hour averages of the mass concentration. Both analog and RS232 outputs are available to transmit the measurements to a user’s data acquisition system. The instrument’s internal storage buffer can store a large amount of data for later viewing on the instrument’s display or downloading over the RS232 output.

There are five air stream flows in the FDMS Series 8500 Monitor: the main flow, base flow, reference flow, bypass flow, and the purge flow (Figure 1-5).

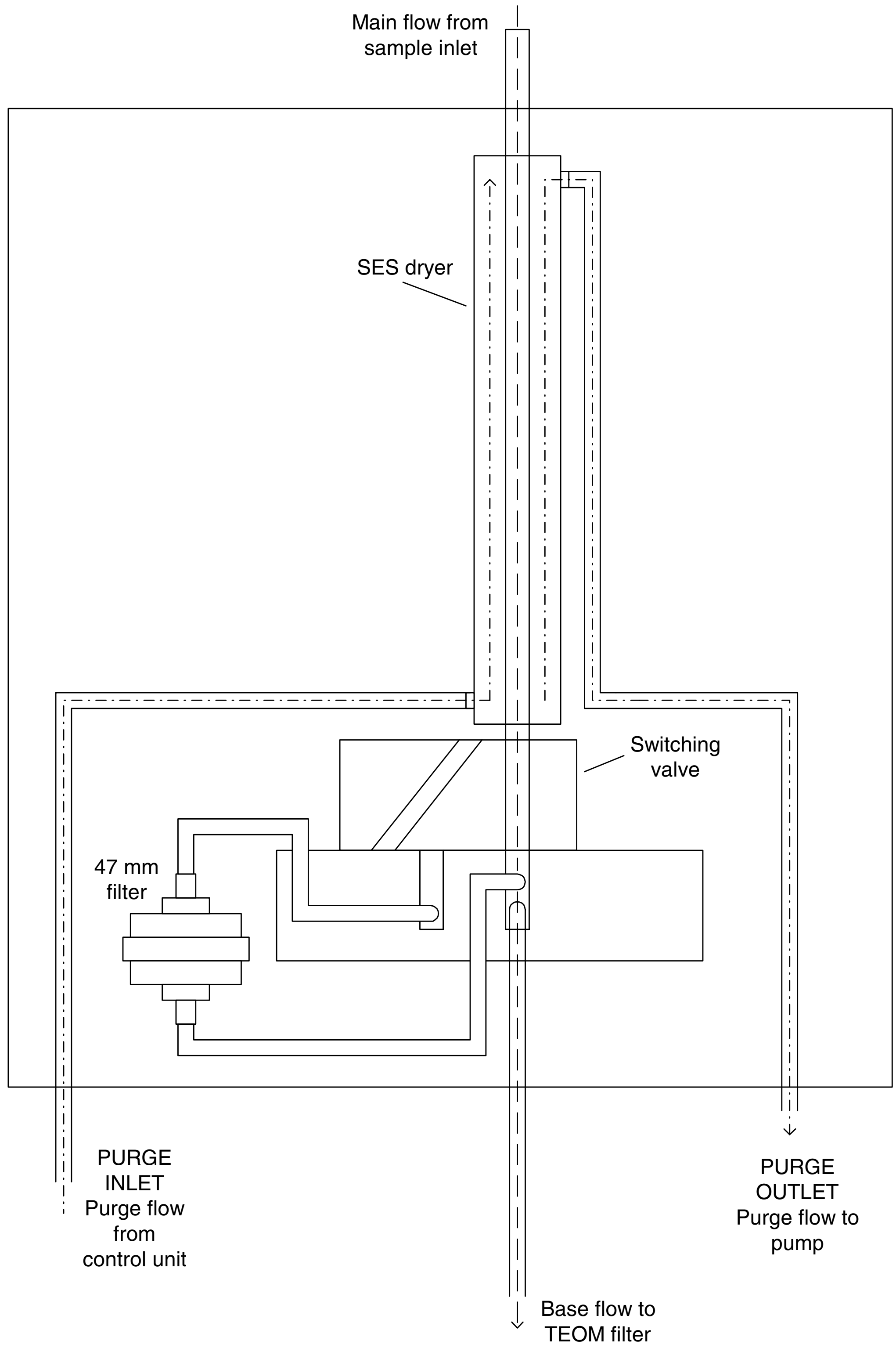
Figure 1-5. Flow diagram of a typical installation.



Main Flow
After passing through a PM-10, PM-2.5 or PM-1 size-selective sample inlet (Figure 1-5), the sample stream is split isokinetically into a main flow of 3 l/min that is used for the automated PM measurement and a bypass flow of 13.7 l/min. The main flow enters the 8500 module (Figure 1-5) where it becomes the base flow (Figure 1-6) or the reference flow (Figure 1-7), depending on the valve position inside the 8500 module.

Base Flow
Inside the 8500 module, the base flow (Figure 1-6) is dried in an SES diffusion dryer that minimizes relative humidity effects upon PM measurements. The base flow then enters the TEOM Series 1400a sensor unit (Figure 1-5). In the sensor unit, the base flow passes through an exchangeable collection filter that is mounted on a TEOM microbalance. This mass transducer continuously provides a direct measurement of the PM mass collected on the filter. After the base flow passes through the TEOM filter, it enters the TEOM Series 1400a control unit where an electronics system transmits the appropriate set points to the main mass flow controller to maintain constant volumetric flow rates. This active volumetric control (ActiVol™) system is based upon inputs from ambient temperature and pressure sensors. When the base flow exits the TEOM Series 1400a control unit it becomes the purge flow.

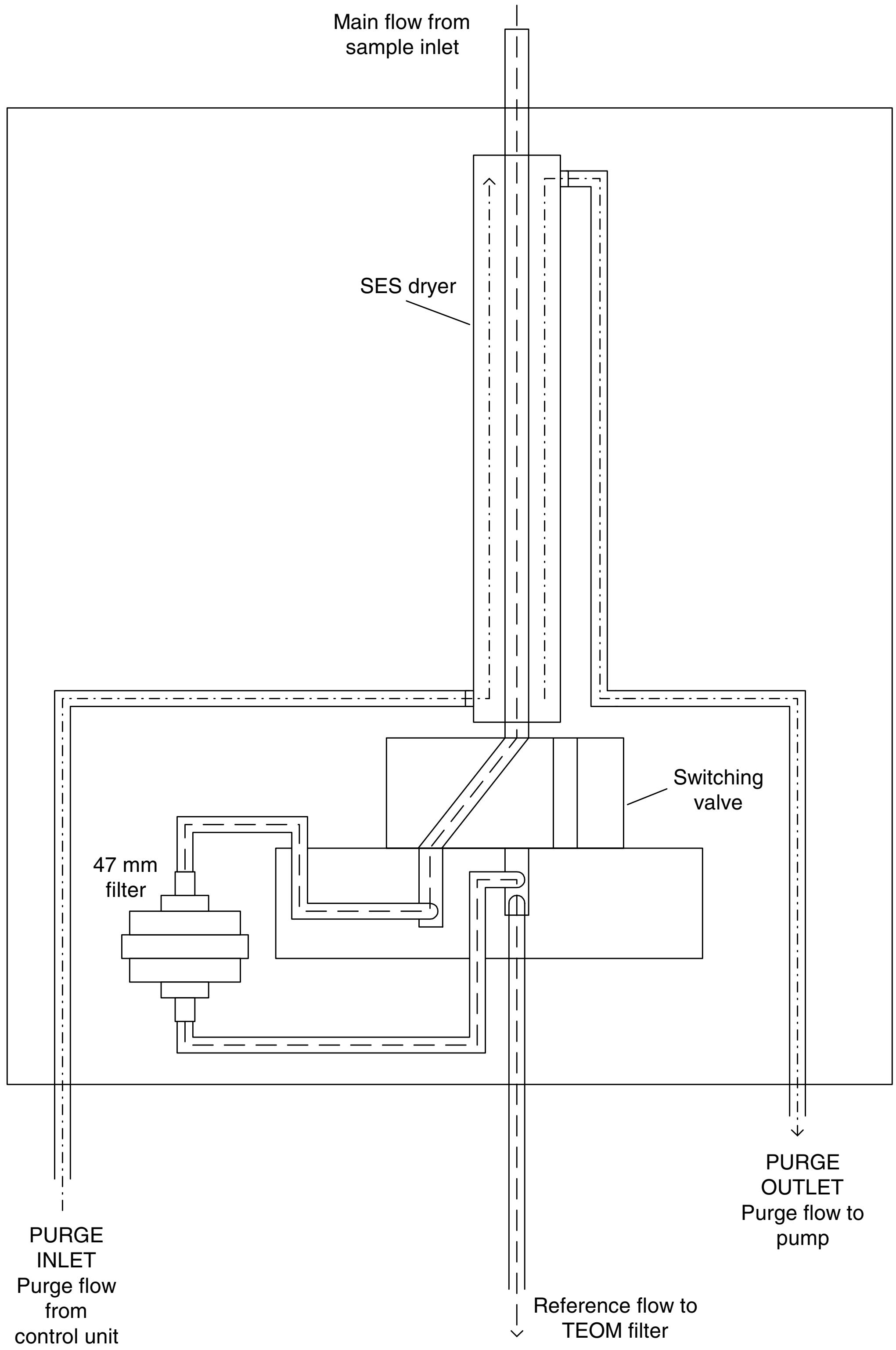
Figure 1-6. Base flow diagram inside the 8500 module.



Reference Flow

Inside the 8500 module, the base flow is dried in an SES diffusion dryer that minimizes relative humidity effects upon PM measurements. A switching valve positioned after the SES dryer changes the flow path of the base/reference flow every six minutes. The sampling process consists of alternate base and reference cycles. During the reference cycle, the air flow passes through a 47 mm filter where it becomes the reference flow (Figure 1-7). The 47 mm filter in the 8500 module produces a sample air stream without particulate matter. The 47 mm filter is maintained at 4° C to provide a time-integrated sample that can be used for subsequent chemical analysis. The 8500 module contains a standard FRM-style molded filter cassette which contains a 47 mm diameter, TX40 material filter. The reference flow then enters the TEOM Series 1400a sensor unit (Figure 1-5). In the sensor unit, the reference flow passes through an exchangeable collection filter that is mounted on a TEOM microbalance. This mass transducer continuously provides a direct measurement of the PM mass collected on the filter. After the reference flow passes through the TEOM filter, it enters the TEOM Series 1400a control unit where an electronics system transmits the appropriate set points to the main mass flow controller to maintain constant volumetric flow rates. This active volumetric control (ActiVol™) system is based upon inputs from ambient temperature and pressure sensors. When the reference flow exits the TEOM Series 1400a control unit it becomes the purge flow.

Figure 1-7. Reference flow diagram inside the 8500 module.



Purge Flow

When the base/reference flow leaves the control unit it travels back to the 8500 module to become the purge flow (Figures 1-5, 1-6 and 1-7). Inside the 8500 module, the purge flow enters the SES dryers where it flows around the base/reference flow to dry the ambient air sample entering the system. This system achieves an effective drying of the base/reference flow to less than 30% relative humidity without requiring any bottled gases or specialized electrical components. The purge flow then enters the pump, and exits from the 8500 system.

The mass reading obtained while sampling particle-laden air is adjusted for any mass change that occurs while the reference flow passes through the filter. For example, if the unit measures a decrease of filter mass during the six-minute reference flow period, this mass decrease is added back to the mass measurement obtained with particle-laden air (base flow). In this manner, the FDMS system compensates for the volatilization effects that can occur in filter-based PM continuous monitors or integrated samplers.

All measurement and temperature functions of the instrument are controlled by a dedicated microcontroller. This computer has both digital and analog capability for multipurpose interfacing with external data collection systems.

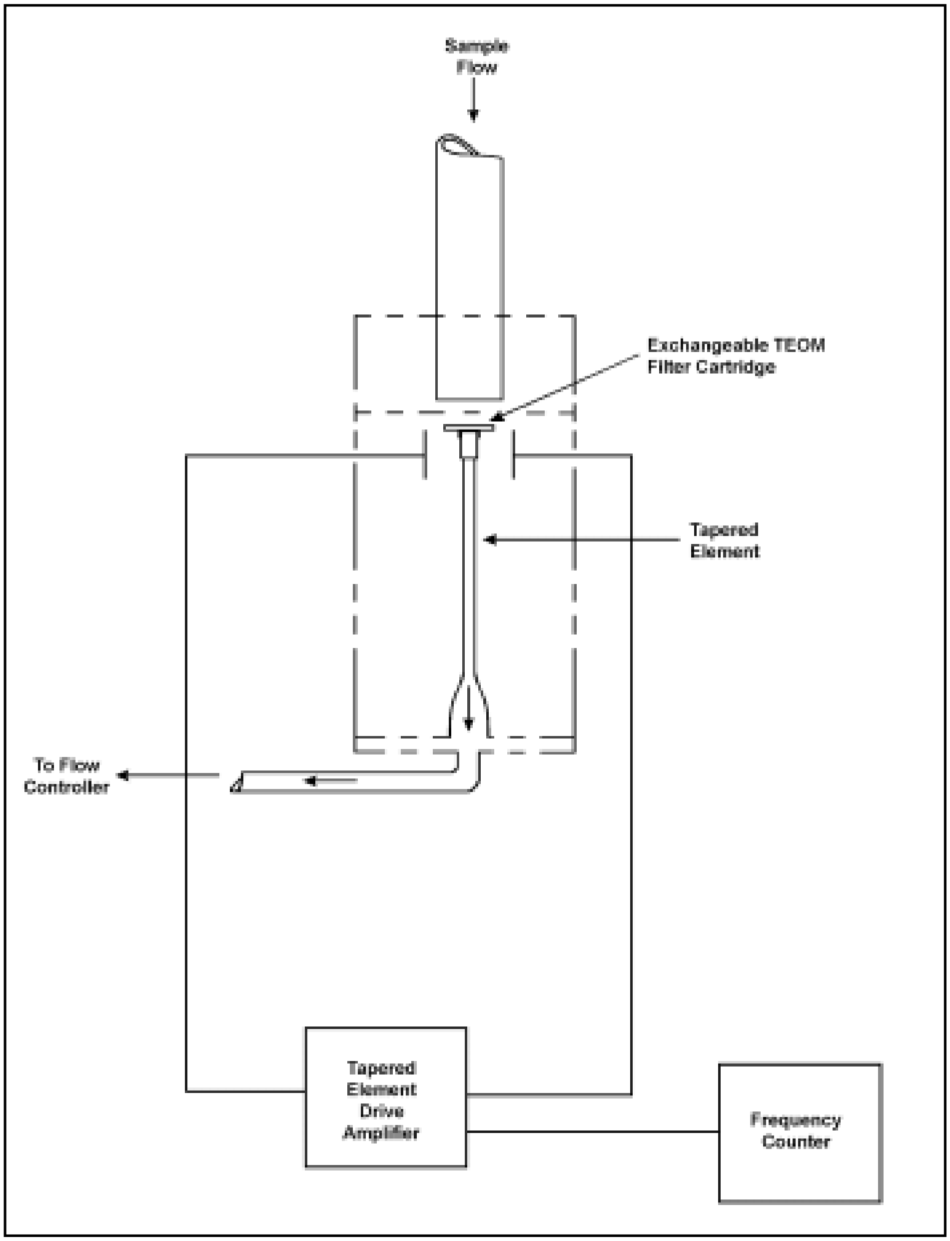
Bypass Flow

After passing through a PM-10, PM-2.5 or PM-1 size-selective sample inlet (Figure 1-5), the sample stream is split isokinetically into a main flow of 3 l/min that is used for the automated PM measurement and a bypass flow of 13.7 l/min (Figures 1-5, 1-6 and 1-7). The bypass flow enters the TEOM Series 1400a control unit where an electronics system transmits the appropriate set points to the bypass mass flow controller to maintain constant volumetric flow rates. This active volumetric control (ActiVol™) system is based upon inputs from ambient temperature and pressure sensors. When the bypass flow exits the TEOM Series 1400a control unit it then enters the pump, and exits from the 8500 system.

1.6. MASS TRANSDUCER OPERATION

The weighing principle used in the TEOM mass transducer (Figure 1-8) is similar to that of a laboratory microbalance in that the mass detected by the sensor is the result of the measurement of a change in a parameter (in this case, frequency) that is directly coupled via a physical law (or from first principles).

Figure 1-8. Schematic diagram of mass transducer.



The tapered element at the heart of the mass detection system is a hollow tube, clamped on one end and free to oscillate at the other. An exchangeable TEOM filter cartridge is placed over the tip of the free end. The sample stream is drawn through this filter, and then down the tapered element. This flow is maintained at a constant volume by a mass flow controller that is corrected for local temperature and barometric pressure.

The tapered element oscillates precisely at its natural frequency, much like the tine of a tuning fork. An electronic control circuit senses this oscillation and, through positive feedback, adds sufficient energy to the system to overcome losses. An automatic gain control circuit maintains the oscillation at a constant amplitude. A precision electronic counter measures the oscillation frequency with a 2-second sampling period.

The tapered element is, in essence, a hollow cantilever beam with an associated spring rate and mass. As in any spring-mass system, if additional mass is added, the frequency of the oscillation decreases. This can be seen by observing the frequency on the four-line display of the TEOM control unit (Section 4), and operating the Series 8500 FDMS Monitor both with and without a filter in place.

In a spring-mass system the frequency follows the equation:

$$f = (K / M)^{0.5} \qquad (1)$$

where:

f = frequency (radians/sec)
K = spring rate
M = mass

K and M are in consistent units. The relationship between mass and change in frequency can be expressed as:

$$dm = K_0 \left(\frac{1}{f_1^2} - \frac{1}{f_0^2} \right) \qquad (2)$$

where:

dm = change in mass
K_0 = spring constant (including mass conversions)
f_0 = initial frequency (Hz)
f_1 = final frequency (Hz)

When this equation is rearranged, you can solve for the spring constant, K_0:

$$K_0 = \frac{dm}{\frac{1}{f_1^2} - \frac{1}{f_0^2}} \qquad (3)$$

✔ Each TEOM instrument has a unique calibration constant, K_0.

Thus, K_0 (the calibration constant for the instrument) can be easily determined by measuring the frequencies with and without a known mass (pre-weighed TEOM filter cartridge).

1.7. Mass Flow Controllers

The mass flow controllers (MFCs) in the Series 8500 FDMS Monitor are internally calibrated for a standard temperature and pressure of 0° C and 1 Atmosphere (1013.2 millibars or 760 mm Hg). The user must enter the seasonal average temperature (Ave. Temp.) and average barometric pressure (Ave. Pres.) at the measurement site to allow the instrument to sample at the correct volumetric flow rate (Section 6).

Alternately, the user can set up the instrument to automatically measure the ambient temperature and pressure using hardware supplied with the unit. The microprocessor calculates the correct mass flow set point ($Flow\_Rate_{STP}$) with this information using the following formula:

$$Flow\_Rate_{STP} = Flow\_Rate_{Vol} \times \frac{273.15}{\text{Ave. Temp.} + 273.15} \times \frac{\text{Ave. Pres.}}{1.0} \qquad (4)$$

where:

$Flow\_Rate_{STP}$ = Control setpoint to mass flow controller (equivalent flow at 0° C and 1 Atmosphere)

$Flow\_Rate_{Vol}$ = Volumetric flow rate setpoint (l/min) to be 3.0 l/min for the sample (main) flow and 13.67 l/min for the auxiliary flow (Section 6)

Ave. Temp. = Seasonal average temperature entered by the user (°C)

Ave. Pres. = Seasonal average barometric pressure entered by the user (Atmospheres, where 1 Atmosphere = 1013.2 millibars or 760 mm Hg)

> NOTE: When using actual conditions for active volumetric flow control, substitute the actual (local) temperature and pressure for the average temperature and pressure variables in equation 4.

PM-10 mass concentration data reported to the U.S. EPA must be referenced to standard cubic meters of air based on a standard temperature and pressure of 25° C and 1 Atmosphere (atm), respectively. For the instrument to report mass concentrations according to this EPA standard, the user must ensure that the standard temperature (Std. Temp.) and standard pressure (Std. Pres.) entered in the instrument equal 25° C and 1 Atmosphere (Section 6). These are the default values for the instrument.

The flow rates referenced internally by the instrument to 0° C are converted to EPA standard conditions using the following computation:

$$\text{Flow\_Rate}_{EPA} = \text{Flow\_Rate}_{STP} \times \frac{\text{Std. Temp.} + 273.15}{273.15} \times \frac{1 \text{ atm}}{\text{Std. Pres.}} \quad (5)$$

NOTE: When reporting concentrations to actual conditions, the values for standard and average temperatures must be set to “99,” and the standard and average pressures must be set to “9,” when in the Set Temps/Flows screen (Section 6). This will ensure that the monitor uses the current actual values for temperature and pressure in equation 5.

1.8. Operating Conditions

In some operating conditions, the Series 8500 FDMS Monitor may require additional steps to reduce the chance of condensation inside the system.

Do not operate the Series 8500 FDMS Monitor without a taking precautions to reduce condensation if the external dew point temperature (outside, at the inlet) exceeds the ambient temperature that the control and sensor unit will be operated in (indoors or in an enclosure). The control unit may be located in any convenient indoor location which is maintained between 2° and 25° C (35° to 77° F). For example, if the dew point at the inlet is 24° C (75° F), and the indoor temperature of your facility is 20° C (68° F), you must take additional steps to prevent condensation. However is your site is 25° C (77° F) and the dew point is 23° C (73° F), you can safely operate the monitor.

If you have purchased the Series 8500 FDMS Monitor Module as an add-on kit to an already existing TEOM 1400a system, your existing 1400a control unit must have the second generation flow controllers (Section 2.1). If you purchased your Series 1400a Monitor before February 2001, or if the serial number on your monitor is 140AB234170011 or below, your control unit may have the original design mass flow controllers. Refer to Section 2.1 for additional information on determining if you have the original design mass flow controllers and how to replace them.

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Section 2: Hardware Installation

To install the Series 8500 FDMS Monitor and set up the system, you must check the voltage setting of the control unit (Section 2.4.1); assemble the main flow connections (Section 2.4.3.1), the bypass flow connections of the control unit (Section 2.4.3.2), the 8500 module (Section 2.4.4), the electrical connections (Section 2.4.5), the sensor unit connections (Section 2.4.6), the flow splitter (Section 2.5.1), the tripod (Section 2.5.2), the sample tube (Section 2.5.3), and the sampling system components (Section 2.5.4); and install a sample inlet onto the flow splitter (Section 2.5.5). After you have set up the system, you must perform a leak check on the monitor (Section 3) and install a filter in the mass transducer and the 8500 filter conditioner unit (Section 3) before starting a sample run.

2.1. Installation Considerations

The Series 8500 FDMS Monitor consists of three basic components: the TEOM Series 1400a sensor unit (containing the sample inlet and mass transducer), TEOM Series 1400a control unit (containing the operator terminal and control electronics), and the 8500 module. If you have purchased the Series 8500 FDMS Monitor as a total package, including the Series 1400a control and sensor units and 8500 module, follow all instructions in this section with the exception of Section 2.3 (Converting a 1400 Control Unit). If you have purchased the 8500 module as an add-on kit, you must follow the instructions in these subsections only: Section 2.3. (Converting a 1400 Control Unit), Section 2.4.2 (8500 Module Brace), Section 2.4.3 (Control Unit Connections), Section 2.4.4 (8500 Module Installation), Section 2.4.5 (Electrical Connections), Section 2.5.3 (Sample Tube Assembly), and Section 2.5.4 (Sampling System Setup, steps 15-20 only).

✔ The instrument must be located in a weather-protected environment.

> **IMPORTANT:** If you are running your TEOM Series 1400a System with a flow adapter installed inside the flow splitter, you MUST REMOVE the flow adapter from the inside of the flow splitter.

The control unit may be located in any convenient indoor location which is maintained between 2° and 25° C (35° to 77° F).

✘ Be sure to install the ambient temperature sensor.

Thermo strongly recommends that the sensor unit also be installed in an indoor or weather-protected location. If the sensor unit is installed in an indoor location, the user must run a sampling tube through the roof of the monitoring site.

Although the monitor is inherently rugged, it is a precision instrument. The user will obtain the best operating conditions and longest instrument life when the unit is not exposed to extremes of weather. Filter exchange, in particular, may be best accomplished by a technician operating in an indoor environment where there is no possibility of rain or snow contaminating the filter.

✔ The sample tubing must be vertical.

Be sure to install the ambient temperature sensor. If you do not install the ambient temperature sensor, and set the average temperature to “99” and the average pressure to “9” (Section 5), the mass flow controller will attempt to control the sample flow as if the ambient temperature is absolute zero.

The sample line should proceed in a straight, vertical line from the sample inlet (Section 2.5.5) to the inlet of the sensor unit through a 4 cm (1 1/2") diameter hole in the roof of the monitoring site.

To achieve the best results, locate the sensor unit in an environment with relatively slow temperature fluctuations. Avoid sampling locations with direct exposure to sunlight or that are in close proximity to a heating or air-conditioning outlet. *To avoid condensation in the sample tubing, Thermo strongly recommends that the user insulate the sample tube extensions with pipe insulation when operating the instrument in areas of high humidity.*

If you have purchased the Series 8500 FDMS Module as an add-on kit to an already existing TEOM Series 1400a System, you must add the new dual-flow fitting (Section 2.3.1) and load the new system software that came with the 8500 module into your Series 1400a control unit (Appendix D). This will convert your TEOM Series 1400a System into a Series 8500 FDMS Monitor.

> **IMPORTANT:** If you have purchased the Series 8500 FDMS Module as an add-on kit to an already existing TEOM 1400a System, your existing 1400a system must have the second generation flow controllers (Figure 2-1) installed inside the control unit. If you purchased your Series 1400a System before February 2001, or if the serial number on your monitor is 140AB234170011 or below, your control unit may have the original design mass flow controllers (Figure 2-2). If your flow controllers make a “clicking” sound, you have the original design flow controllers. If you have (or think you have) the original design flow controllers, contact R&P for information on obtaining a Second Generation Mass Flow Controllers replacement kit, and refer to Section 2.3.2 for instructions on replacing the original design flow controllers.

Figure 2-1. Second generation flow controllers.

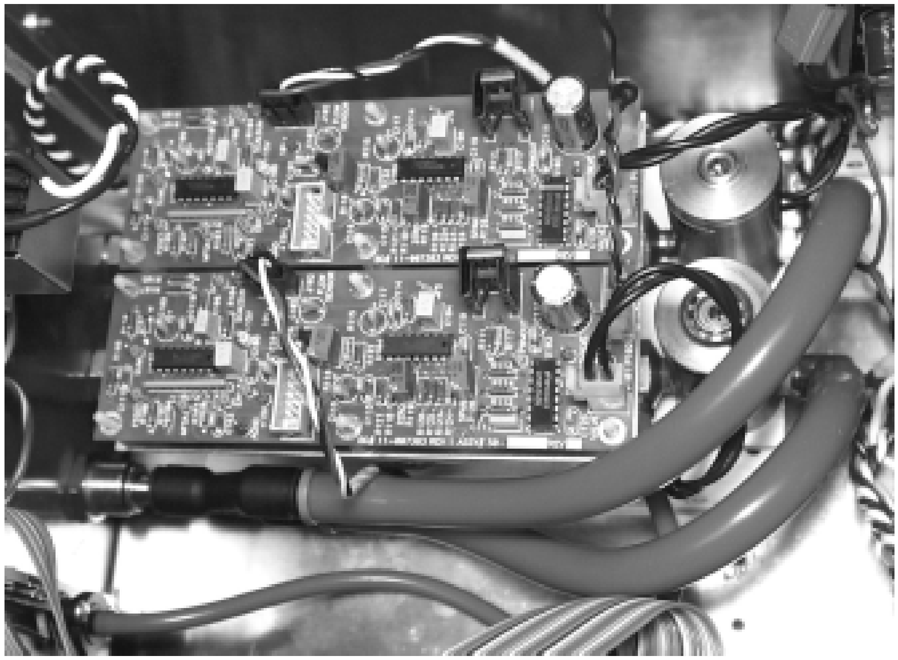
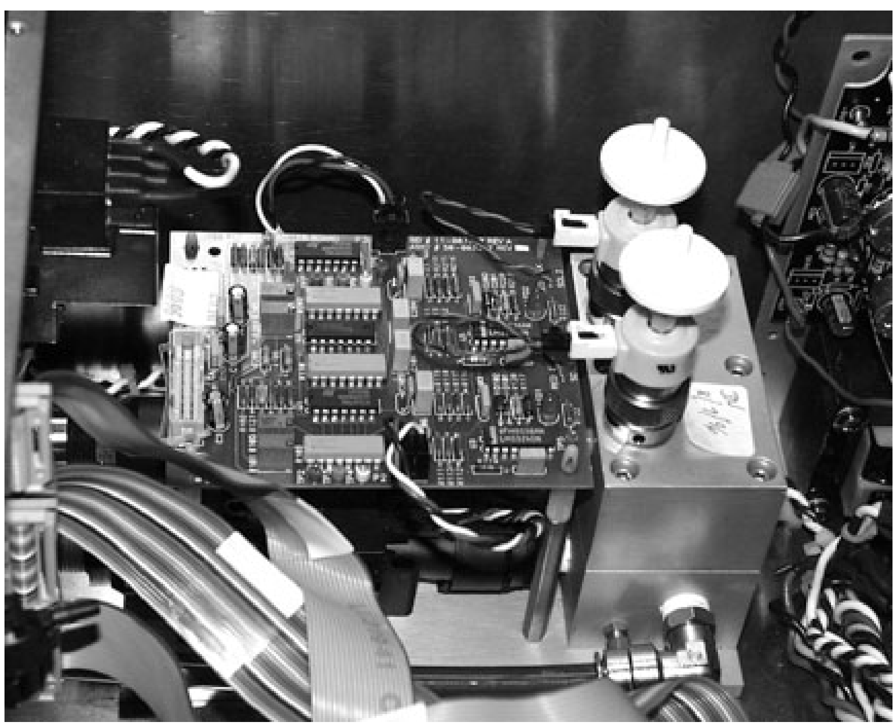


Figure 2-2. Original design flow controllers.



2.2. Standard System Hardware

In its most basic PM-10 configuration, the Series 8500 FDMS Monitor is supplied with the following components:

TEOM Series 1400a control unit (with auxiliary flow controller)
TEOM Series 1400a sensor unit
8500 module
8500 module brace stand and base
8500 FDMS software package
3 10/32-inch x 5/8-inch screws
Vacuum pump
Water condensation trap kit
Temperature sensor and cable, 10 m
Electric- and air-connecting cable
2 2-foot red/black wire lengths, round connector to 15-pin connector
5 m (16.5 ft) 3/8-inch nylon green tubing
3 ft 1/4-inch black tubing
3-inch insulation sleeve
2 sample tube extensions, 1 m (40-inch)
9-to-9 pin RS232 serial pin cable
9-to-15 pin valve signal cable
15-to-15 pin valve position cable
15-to-25 pin data interface cable
9-to-25 pin computer adapter
9-to-25 pin modem cable
Data interface cable, 15-pin to 25-pin
Module connection cable
3 power cables
Box of 20 TEOM filter cartridges
Box of 25 filter cartridges (47 mm Pallflex TX40)
2 filter cassettes
4 large in-line filters
Filter exchange tool
Pre-filter assembly (for baseline testing)
Flow audit filter
Flow splitter
PM-10 inlet
Flow audit adapter kit
Valve cleaning brush
2 15-pin subminiature D-connectors
2 18 mm hex nuts
4 hose barbs

Metal 3/8-inch to 1/4-inch reducer fitting
1/2-inch x 1/2-inch push-to-connect union fitting
3/8-inch x 3/8-inch push-to-connect union fitting
3/8-inch x 3/8-inch push-to-connect elbow fitting
2 3.15 Amp fuses
2 FDMS Series 8500 Operating Manuals (1 binder, 1 on CD-ROM)
2 TEOM Series 1400a Service Manuals (1 binder, 1 on CD-ROM)

2.3. Converting A 1400 Control Unit

If you have purchased the Series 8500 FDMS Module as an add-on kit to an already existing TEOM 1400a System, you must install the dual-flow fitting into the Series 1400a control unit (Section 2.3.1). Also, your Series 1400a control unit must have the second generation flow controllers (Section 2.3.2). Refer to Section 2.1 for assistance in determining if you have the second generation flow controllers.

> NOTE: If you have to install both the dual-flow fitting and the second generation flow controllers, be sure to install the dual-flow fitting first, before installing the second generation flow controllers.

2.3.1. INSTALLING THE DUAL-FLOW FITTING

If you have purchased the Series 8500 FDMS Module as an add-on kit to an already existing TEOM Series 1400a System, you must convert the flow configuration inside the control unit and modify the pump port on the back of the control unit.

Tools and materials needed for this procedure:

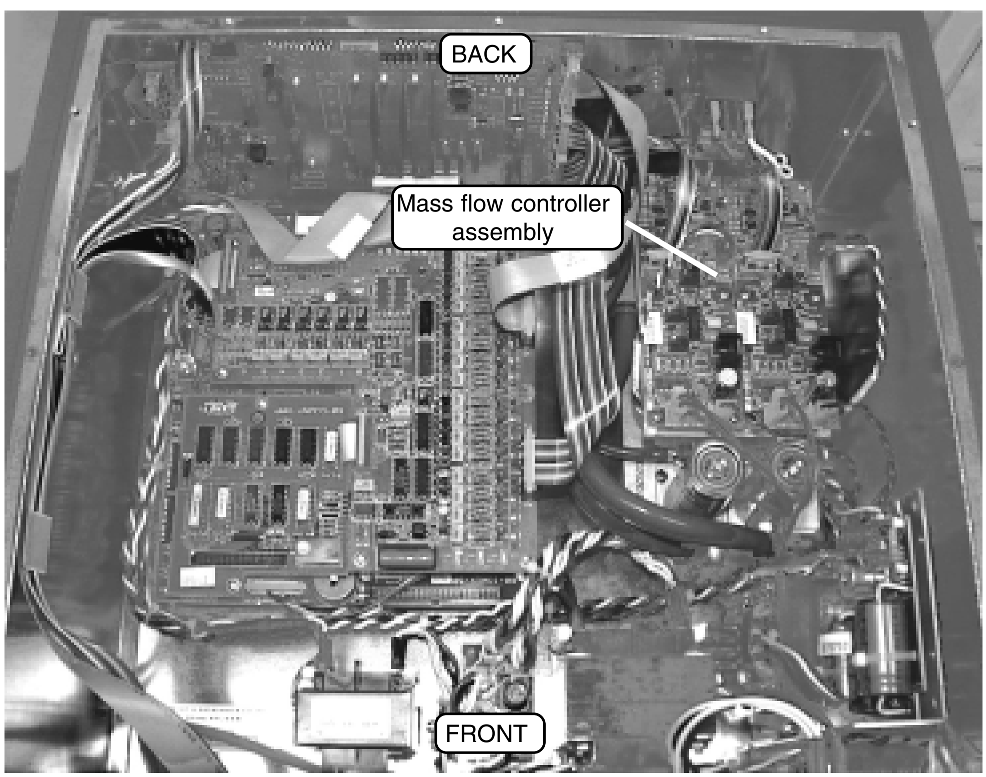
Dual-flow fitting
2 plastic 3/8-inch to 1/4-inch reducer fittings
Adjustable wrench

Follow these steps to install the dual-flow fitting:

1) Remove the top cover of the control unit.

2) Locate the mass flow controller assembly inside the control unit (Figure 2-3) in the back, right-hand corner.

Figure 2-3. Interior view of the control unit.



3) Locate the hoses and Y-fitting connected to the mass flow controller assembly (Figure 2-4).

Figure 2-4. Mass flow controller assembly with Y-fitting and hoses highlighted.

4) Locate the PUMP port on the back (Figure 2-5) and inside (Figure 2-6) of the control unit.

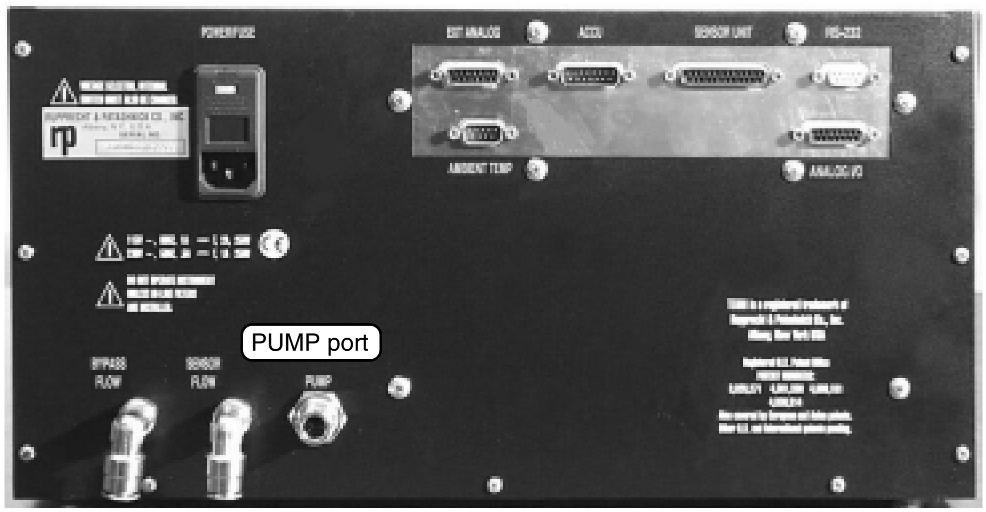


Figure 2-5. Back of the sensor unit with “PUMP” port highlighted.

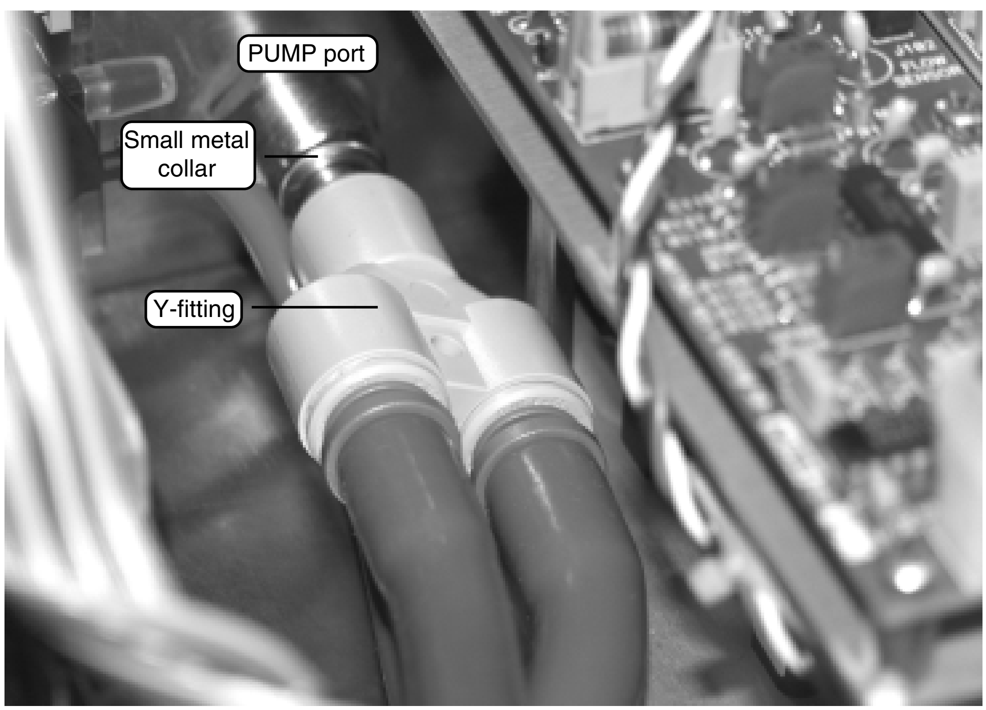


Figure 2-6. Interior of the control unit with “PUMP” port, small metal collar and Y-fitting highlighted.

5) Disconnect the main flow hose and bypass flow hose from the Y-fitting by pushing in on the small collars at the end of the Y-fitting and pulling the hoses out (Figure 2-7).

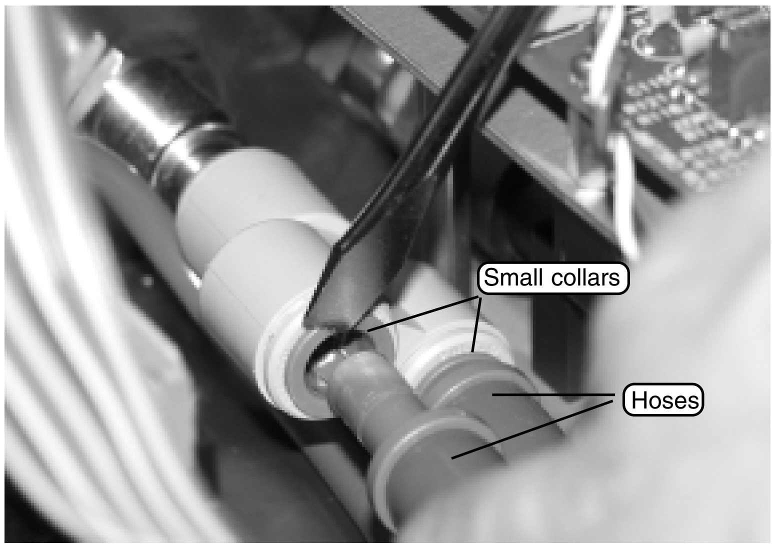


Figure 2-7. Removing a hose from the Y-fitting.

NOTE: Do not remove the rigid hose adapters that are installed inside the ends of the main flow hose and the bypass flow hose (Figure 2-8).

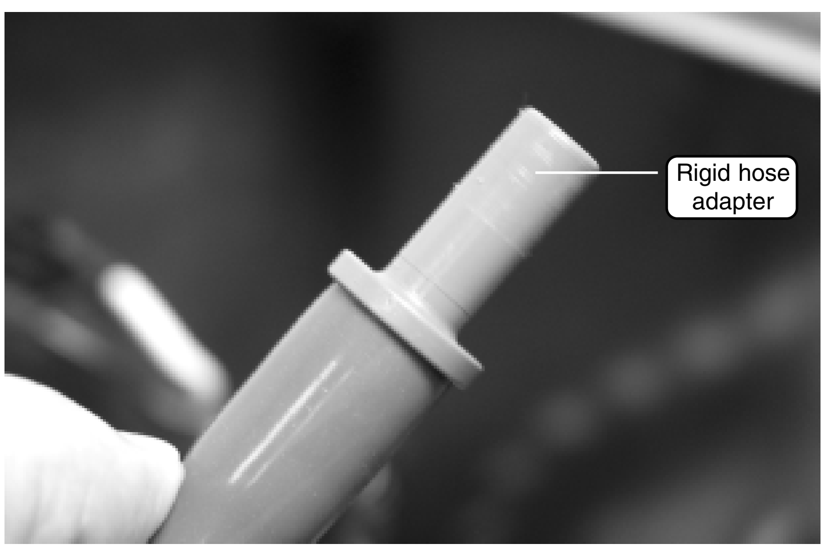
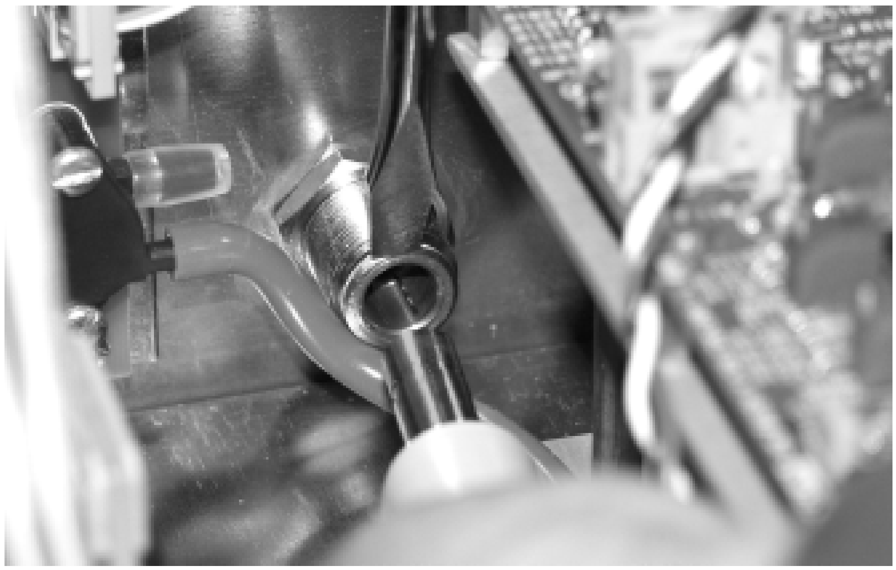


Figure 2-8. Rigid hose adapter installed inside the end of a hose.

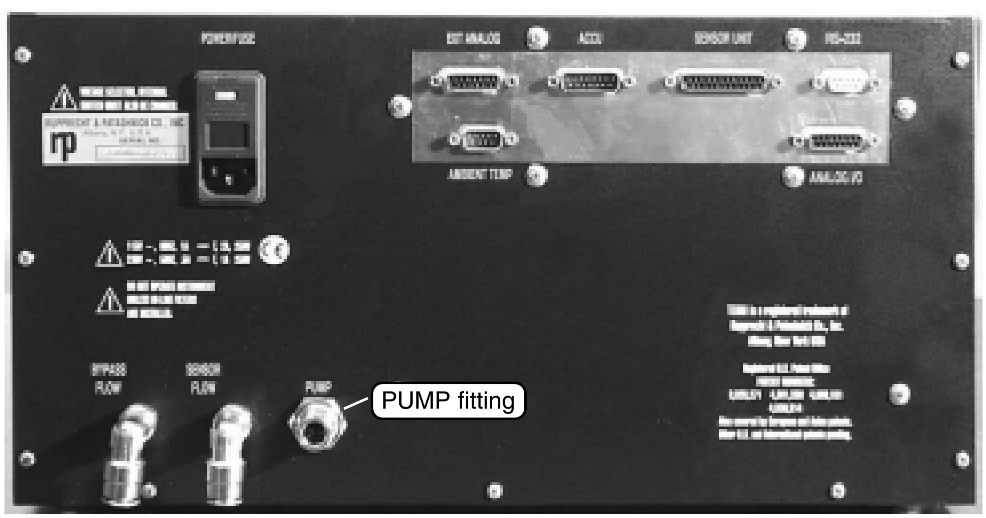
6) Disconnect the Y-fitting from the pump fitting by pushing on the small metal collar at the end of the pump fitting and pulling the Y-fitting out (Figure 2-9).

Figure 2-9. Removing the Y-fitting from the pump fitting.



7) Remove pump fitting from the back of the control unit using the adjustable wrench (Figure 2-10).

Figure 2-10. Back view of the control unit with pump fitting highlighted.



8) Locate the dual-flow fitting (Figures 2-11 and 2-12).

Figure 2-11. Dual-flow fitting.

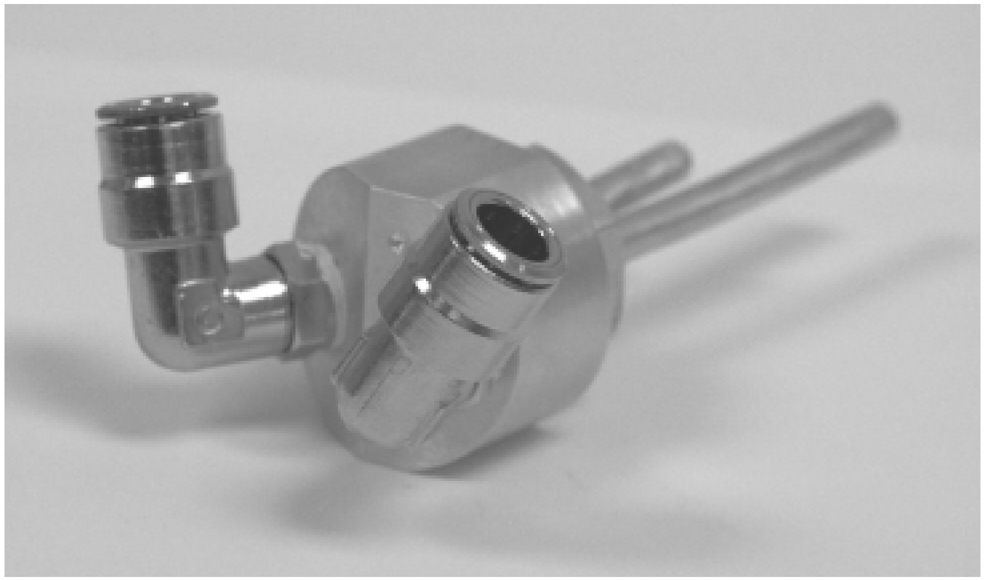
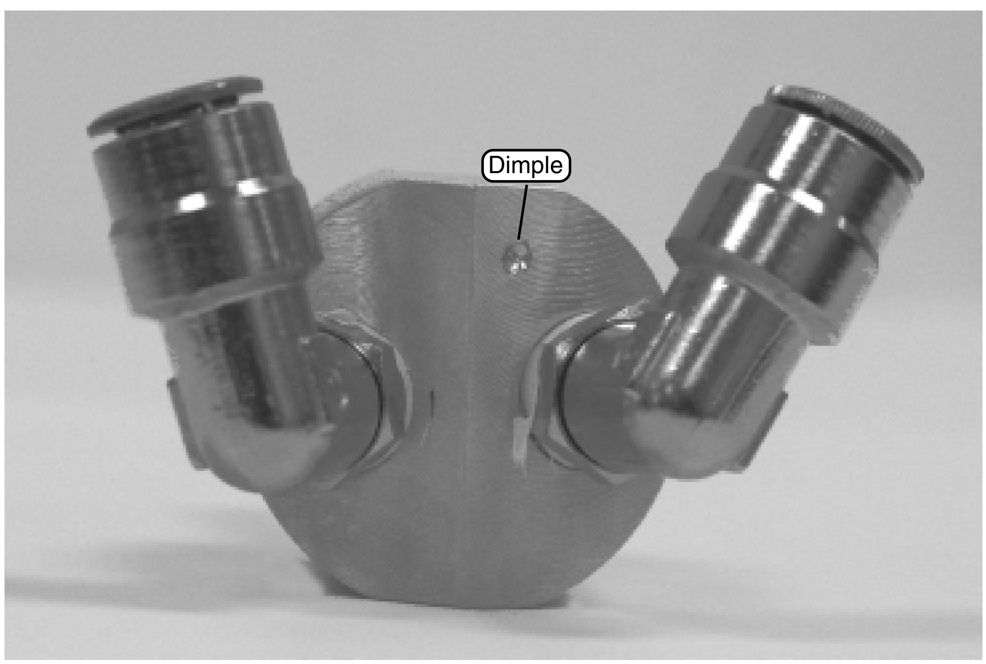


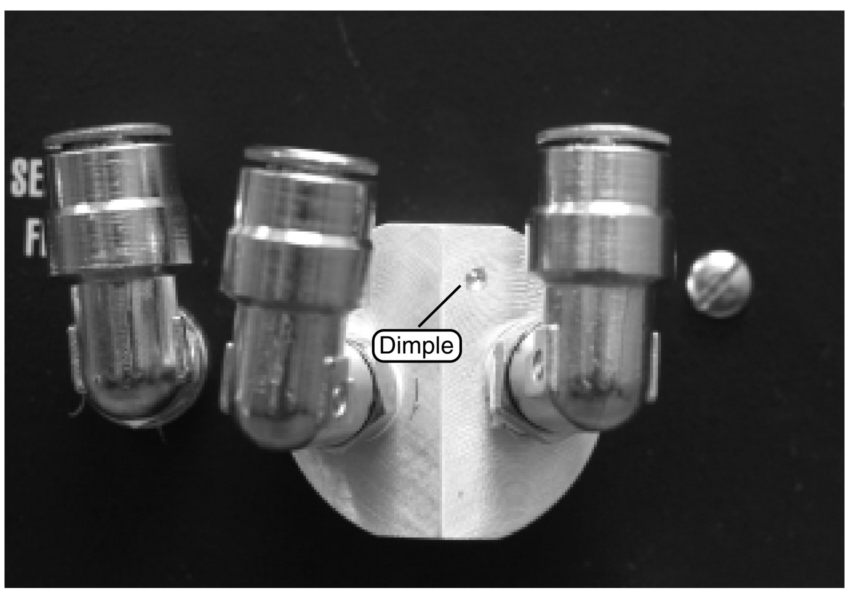
Figure 2-12. Close-up view of the dual-flow fitting with the dimple highlighted.



9) Install the dual-flow fitting through the empty "PUMP" port (Figure 2-13). When looking at the back of the control unit, ensure that the "dimple" marking the reference/base (purge) flow side is located on the right-hand side (Figure 2-14).

Figure 2-13. Dual-flow fitting installed inside the control unit.

Figure 2-14. Dual-flow fitting installed in the control unit with the dimple highlighted.

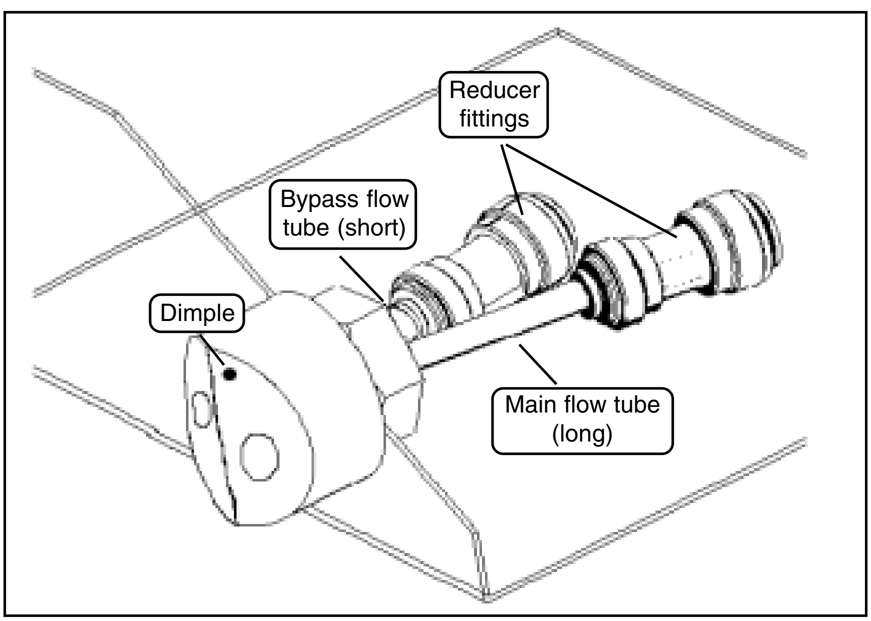


10) Install the dual-flow fitting nut onto the dual-flow fitting (this dual-flow fitting nut should be attached to the dual-flow fitting when you receive it in the installation kit) (Figure 2-15).

Figure 2-15. Dual-flow fitting nut installed on dual flow fitting.

11) Locate the main flow metal tube (long tube, dimpled side) and the bypass flow metal tube (short tube) on the dual-flow fitting (Figure 2-16).

Figure 2-16. Drawing of dual-flow fitting.

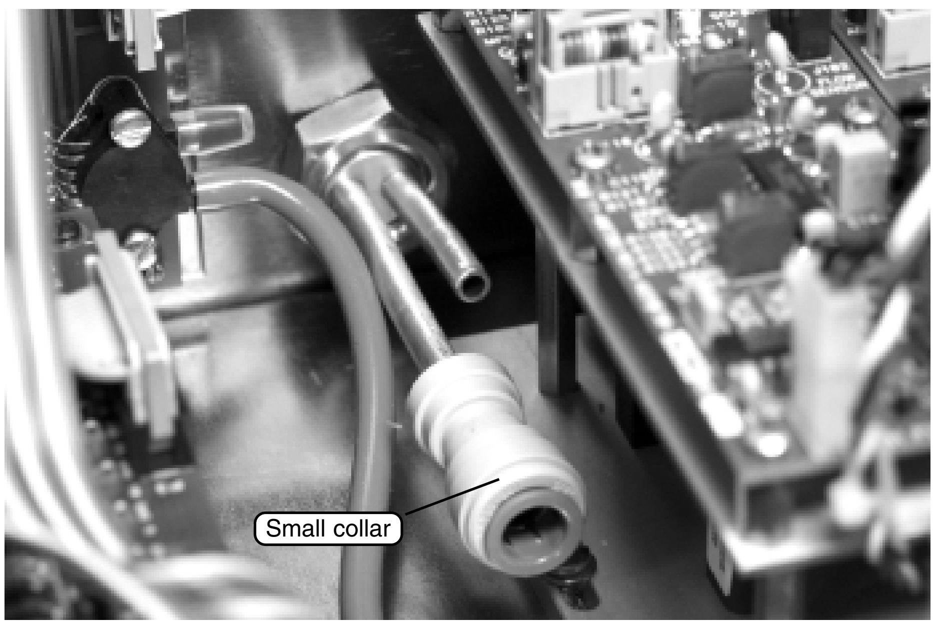


12) Locate the two plastic 3/8-inch to 1/4-inch reducer fittings.

13) Install one plastic 3/8-inch to 1/4-inch reducer fitting on the main flow metal tube (long tube, dimpled side) of the dual-flow fitting (Figures 2-16 and 2-17).

NOTE: The Series 8500 FDMS Monitor uses push-to-connect fittings for all air lines. To engage these connections, the air tube must be pushed completely into the fitting so that the tube is fully inserted and cannot be pulled out. While pushing the tubing into the fitting, there is an intermediate stop at an O-ring. You must push the tubing past the O-ring to completely engage the tubing inside the fitting and prevent air leaks. To disengage the connection, push the small collar (located at the end of the fitting) (Figure 2-16) toward the fitting and pull the tube out.

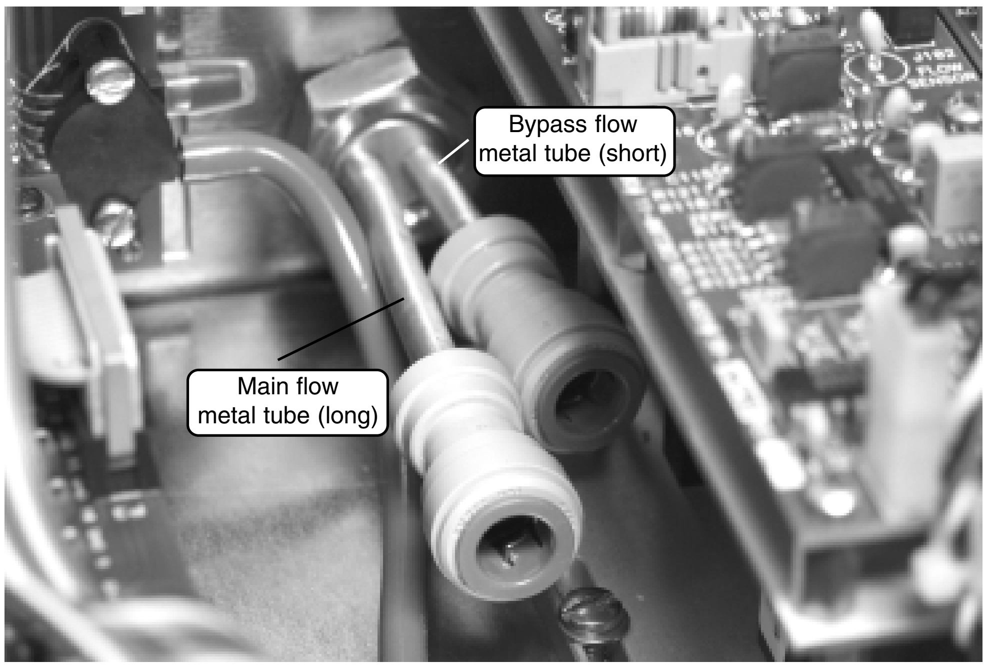
Figure 2-17. Dual-flow fitting with the reducer fitting installed on the main flow metal tube.



14) Slightly bend the main flow metal tube away from the main flow controller assembly, enough to allow you to install the other plastic reducer fitting onto the bypass flow metal tube.

15) Install the other plastic 3/8-inch to 1/4-inch reducer fitting onto the bypass flow metal tube (short tube) of the dual-flow fitting (Figures 2-16 and 2-18).

Figure 2-18. Dual-flow fitting with reducer fittings installed on the main flow metal tube and bypass flow metal tube.



16) Install the main flow hose (from the main flow side of the flow controller) into the 3/8-inch to 1/4-inch reducer fitting on the main flow metal tube (Figure 2-19).

17) Install the bypass flow hose (from the bypass flow side of the flow controller) into the 3/8-inch to 1/4-inch reducer fitting on the bypass flow metal tube of the dual-flow fitting (Figure 2-19).

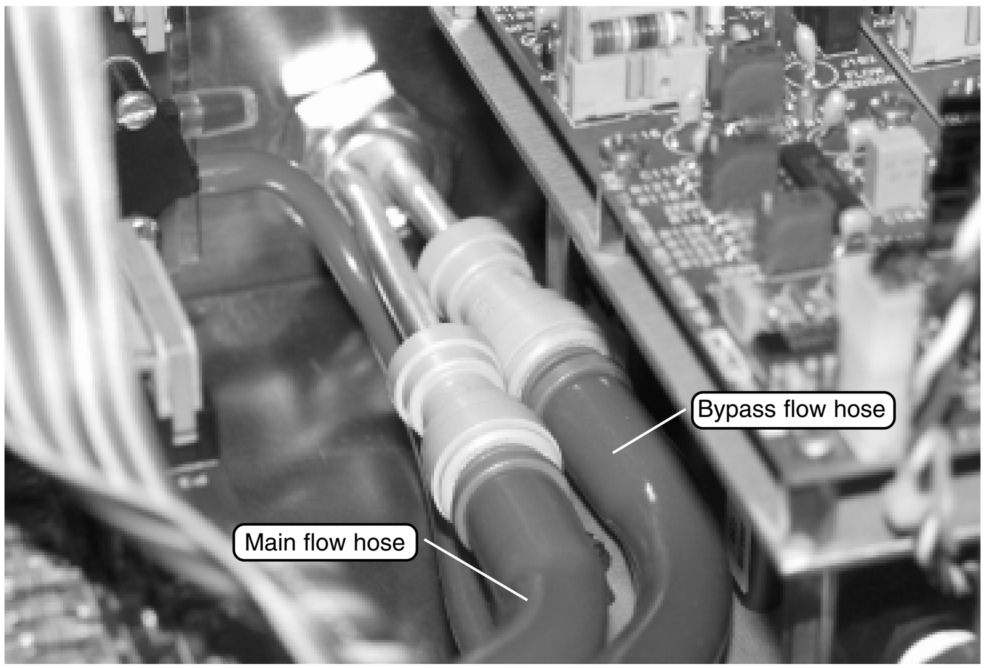


Figure 2-19. Dual-flow fitting with main flow and bypass flow hoses installed.

18) If you must install the second generation flow controllers, go to Section 2.3.2 (Mass Flow Controller Upgrade). If your 1400a System already has the second generation flow controllers installed inside the control unit, go to step 19.

19) Install the top cover onto the control unit, and go to Section 2.4 (Installing the Control and Sensor Units).

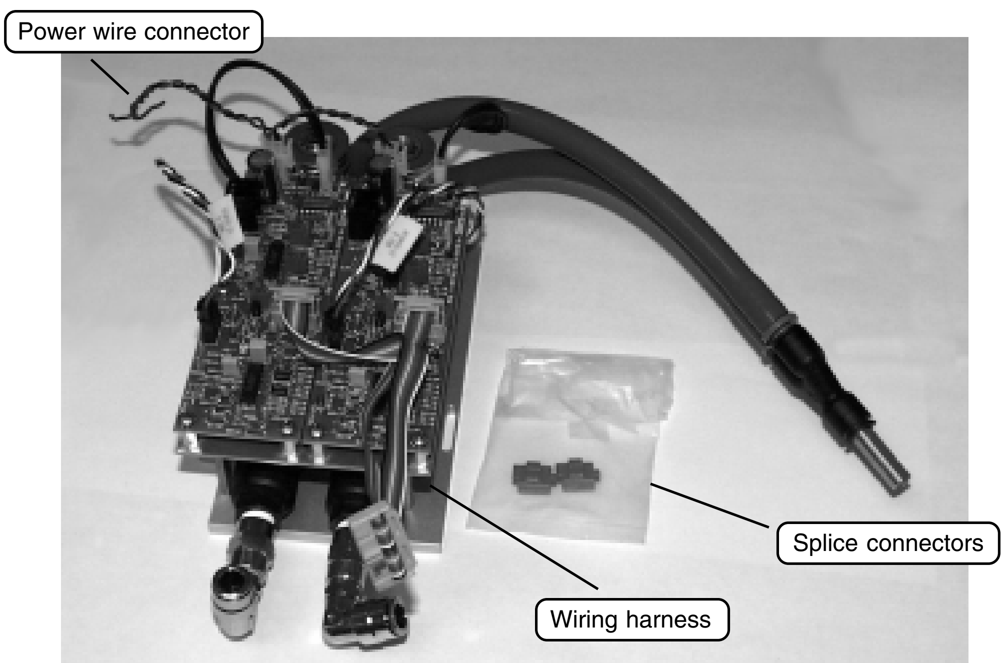
2.3.2. Mass Flow Controller Upgrade

The replacement procedure includes removing the original design mass flow controllers (Section 2.3.2.1), splicing into the control unit's 15-volt power supply (Section 2.3.2.2), installing the new mass flow controllers (Section 2.3.2.3) and testing the new mass flow controllers.

The Mass Flow Controllers Upgrade Kit (Figure 2-20) for the Series 1400a Ambient Particulate Monitor includes:

Assembled, pre-calibrated mass flow controllers with Technocraft valves
Power wire connector for the new controller (attached)
Wiring harness (attached)
Two splice connectors

Figure 2-20. 1400a flow controllers with the Technocraft valves.



2.3.2.1. Removing the Original Mass Flow Controller

Follow these steps to remove the original mass flow controllers:

1) **Turn off and unplug the control unit.**
2) **Remove the top panel from the control unit.**
3) **Locate the original flow controllers at the right-hand rear corner of the unit (Figures 2-21 and 2-22).**

Figure 2-21. Original flow controllers.

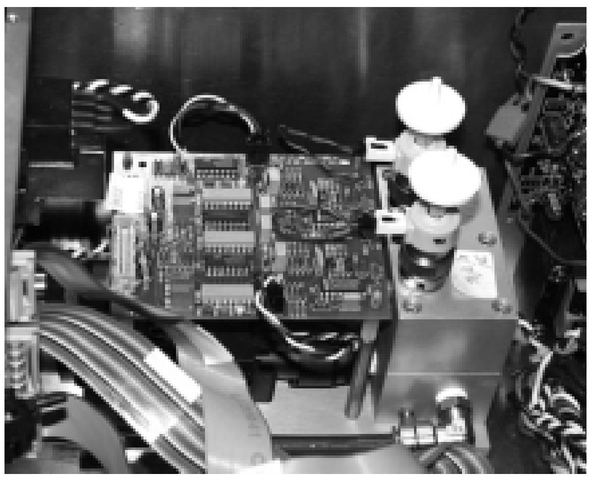
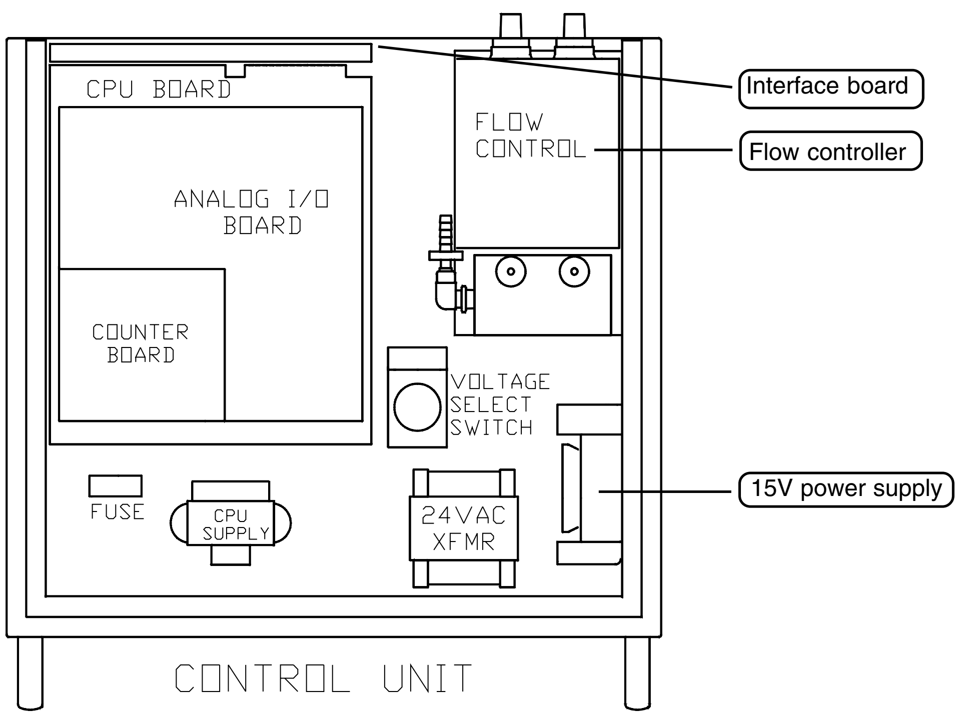


Figure 2-22. Interior diagram of the 1400a control unit with interface board, flow controller and 15V power supply highlighted.



4) Remove the retaining clip and disconnect the bottom wiring harness from the interface board (Figure 2-23). Retaining clips are pieces of thin flexible metal used to secure the cable connectors to the electronics boards (Figure 2-24).

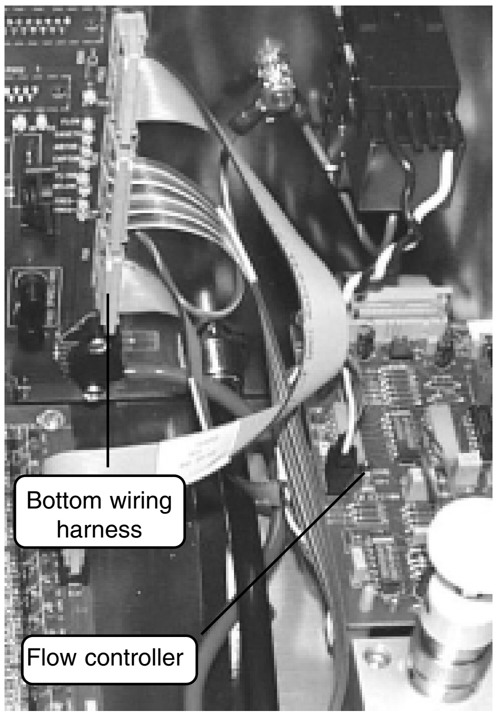


Figure 2-23. 1400a interior with bottom wiring harness on interface board highlighted.

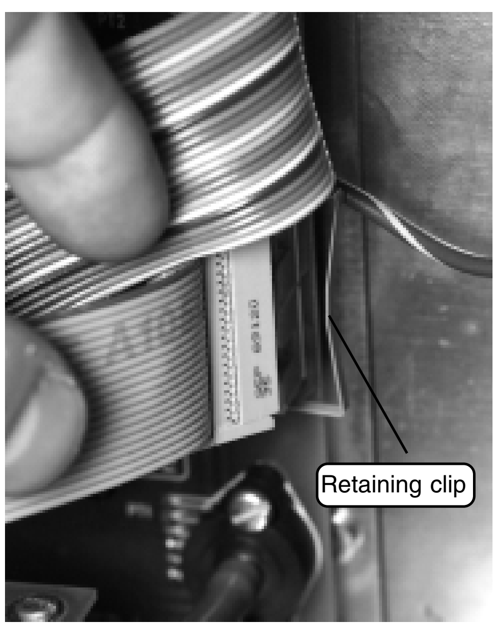


Figure 2-24. Wiring harness connection with retaining clip highlighted.

5) **Disconnect the tubing and elbow fittings from the SENSOR FLOW and BYPASS FLOW ports on the back of the control unit (Figure 2-25).**

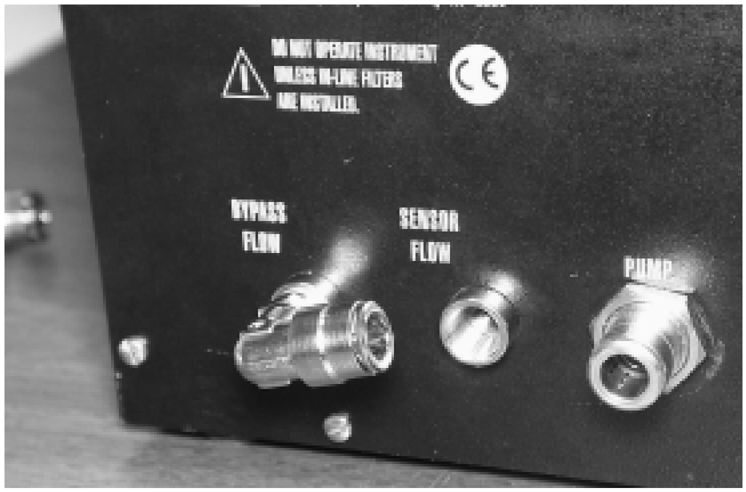


Figure 2-25. Disconnecting bypass and sensor flow elbows.

6) **Disconnect the tube that extends from the side of the mass flow controllers to the pump fitting at the inside back panel (Figure 2-26). Be sure to disconnect the tube at the pump fitting located on the inside back panel.**

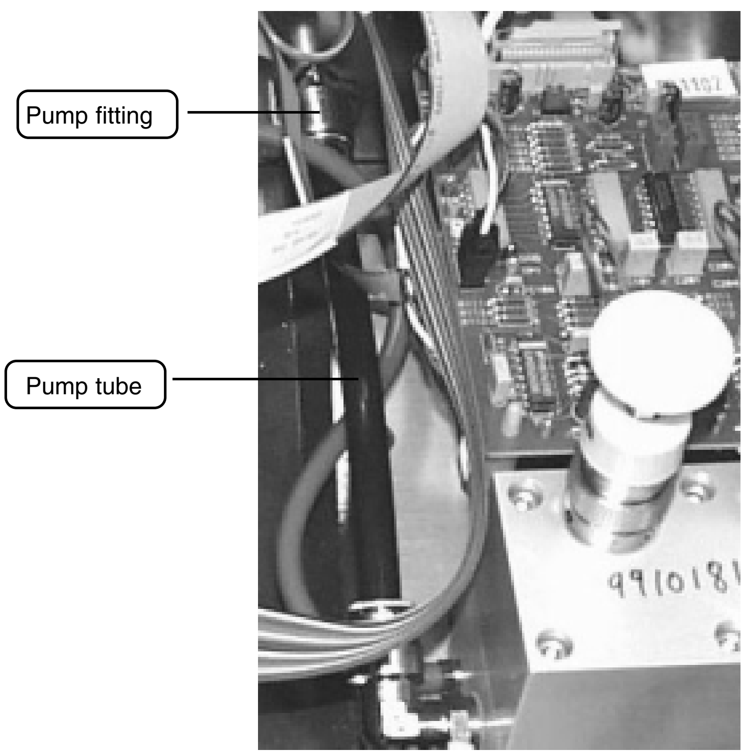
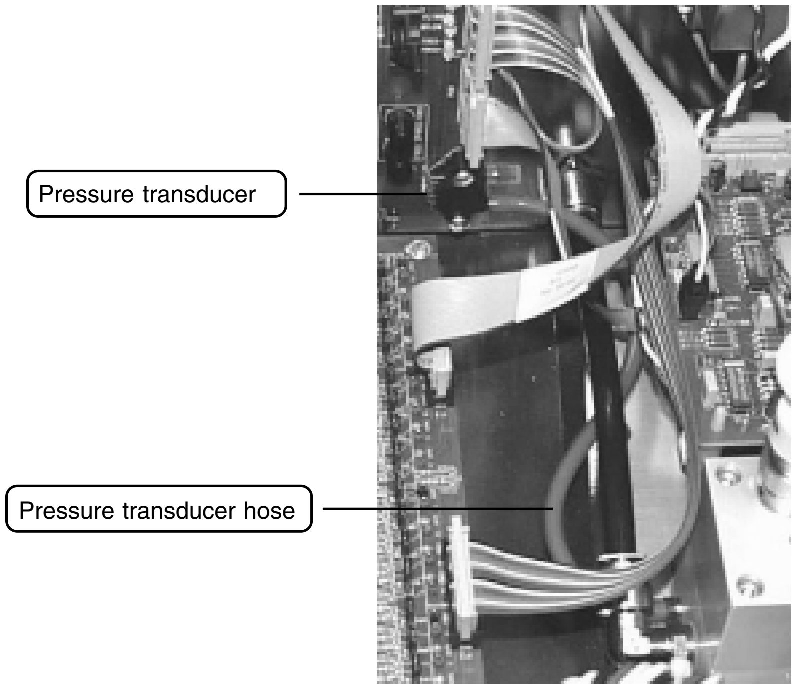


Figure 2-26. Original flow controller with pump tube and fitting highlighted.

7) Disconnect the pressure transducer hose from the mass flow controllers (Figure 2-27).

Figure 2-27. Original mass flow controllers with pressure transducer and pressure transducer hose highlighted.

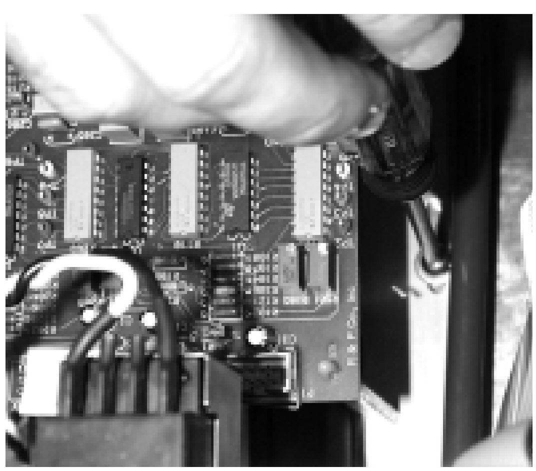


8) Unscrew the two screws that hold the original mass flow controllers to the bottom of the unit (Figure 2-28).

9) Slide the original mass flow controllers back slightly and lift them out of the unit.

NOTE: Save the two screws to install the new mass flow controllers assembly (Section 2.3.2.3).

Figure 2-28. Removing the flow controller screws.



2.3.2.2. Splicing Into the Power Supply

Before installing the new mass flow controllers, you must splice the new valve power connections wire into the 15-volt power supply located in the front, right-hand corner of the unit. Use the supplied splice connectors to splice the attached valve power wire into the power controller mounted in the front, right-hand section of the control unit.

Follow these steps to splice into the power supply:

1) **Turn off and unplug the control unit.**
2) **Locate the power (red) and common (black) wires where they connect to the 15-volt power supply (Figures 2-22 and 2-29).**

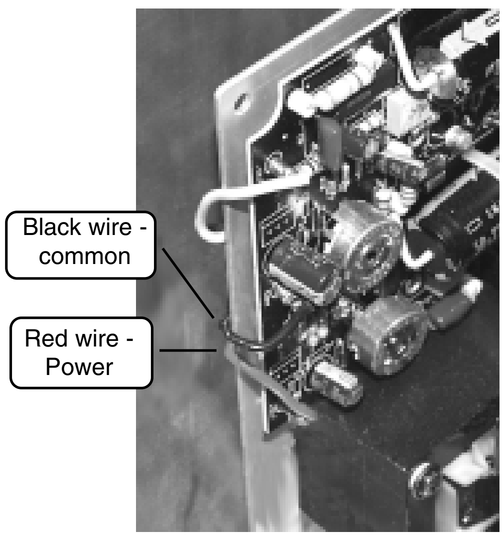


Figure 2-29. 15V power supply with red and black wires highlighted.

3) **Remove the power wire connectors from the new mass flow controllers assembly (Figure 2-30).**

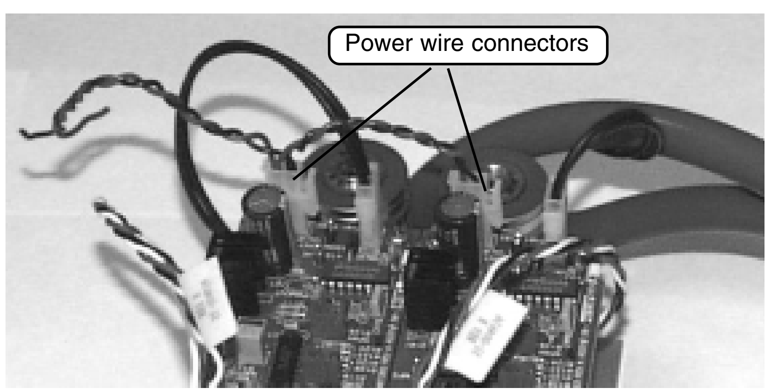


Figure 2-30. New mass flow controllers assembly with power wire connectors highlighted.

4) Use the two quick splice connectors (Figure 2-31) to attach the red wire on the new power wire to the red wire on the power supply and the black power wire on the new power wire to the black wire on the power supply (Figure 2-32).

Figure 2-31. Splice connector.

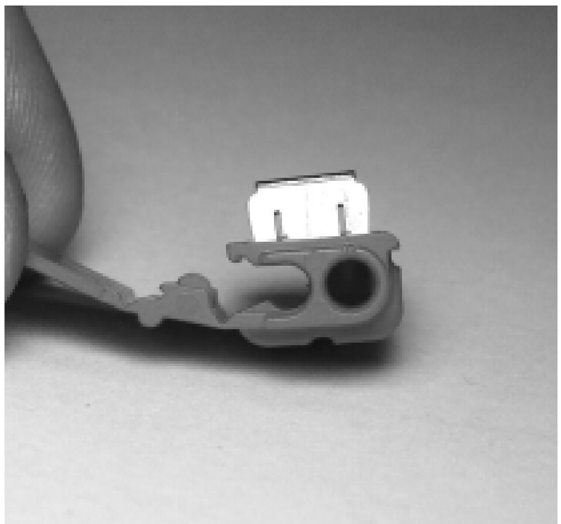
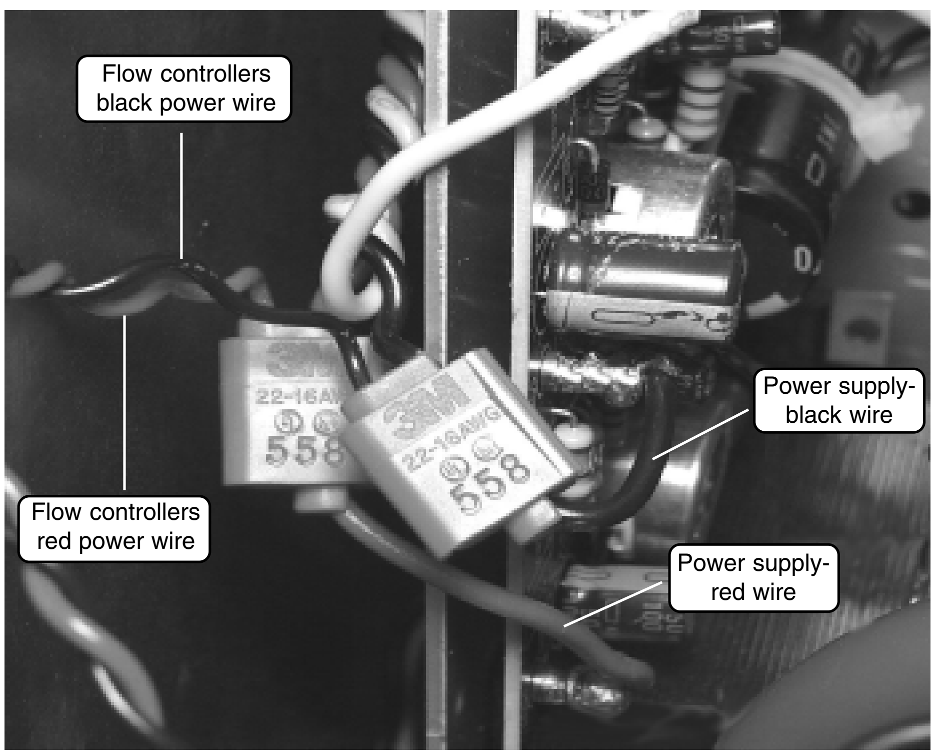


Figure 2-32. Splice connectors connecting new flow controller power wires and 15V power supply.

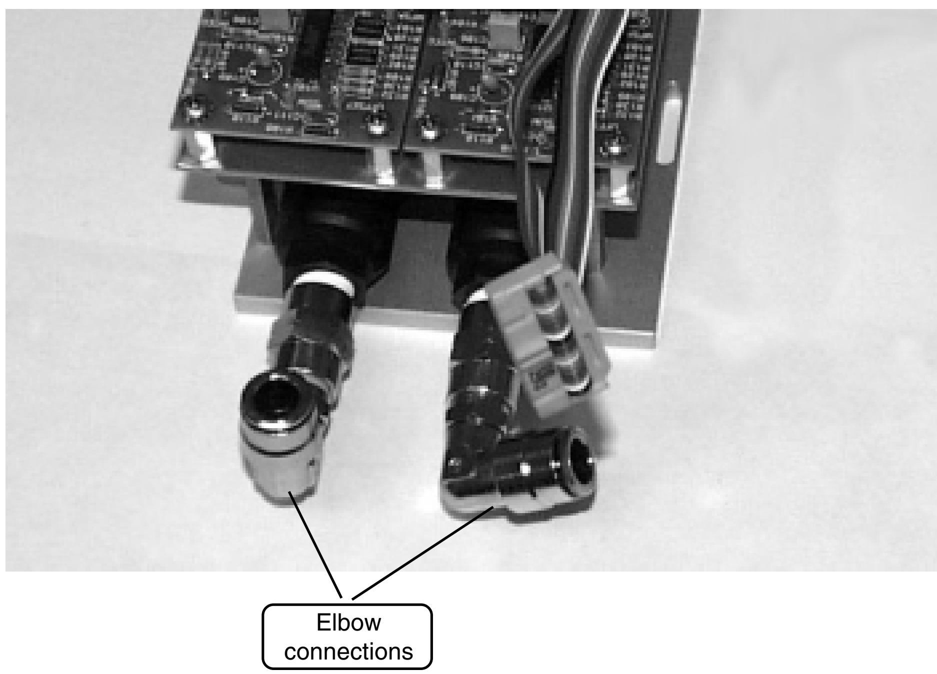


2.3.2.3. Installing the New Mass Flow Controllers Assembly

Follow these steps to install the new mass flow controllers assembly:

1) Disconnect the sensor and bypass elbow connections from the new mass flow controllers assembly (Figure 2-33). Use two wrenches to disconnect the elbow connections. Hold the fittings that are attached to the mass flow controllers assembly steady while loosening the elbow connections. If the fittings that are attached to the mass flow controllers assembly twist while you are disconnecting the elbow connections, the internal O-rings will require 24 hours to completely reseal.

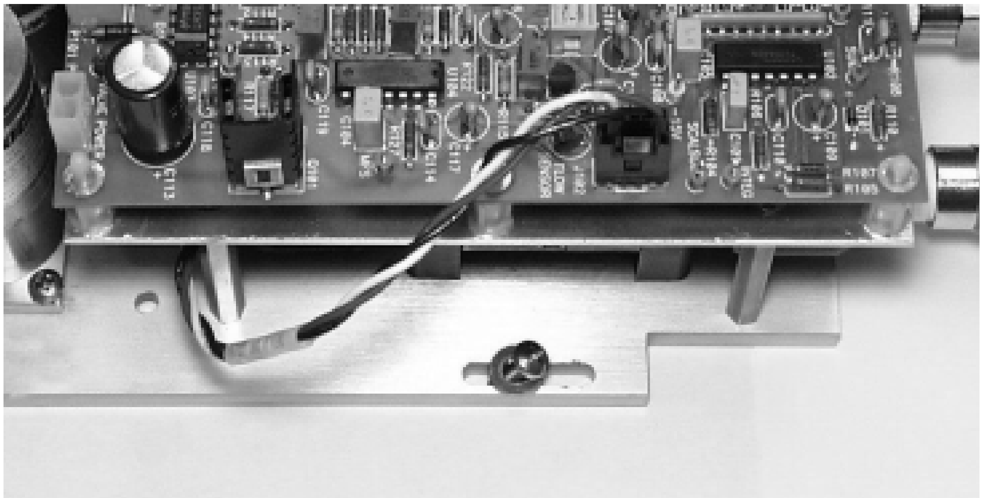
Figure 2-33. New mass flow controllers assembly with elbows highlighted.



2) Insert the two screws from the original mass flow controllers assembly into the slots of the new mass flow controllers assembly (Figures 2-34 and 2-35).

Figure 2-34. Placing screw in flow controller before installation into the control unit.

Figure 2-35. New mass flow controllers assembly with screw inserted into one of the slots prior to installation into the control unit.



3) Slide the unit into the case (Figure 2-36), ensuring that the main and bypass connections line up with the holes in the back of the control unit.

Figure 2-36. Sliding the new mass flow controllers assembly into the control unit.

4) Tighten the two screws that hold the mass flow controllers assembly to the bottom of the control unit (Figures 2-37, 2-38 and 2-39).

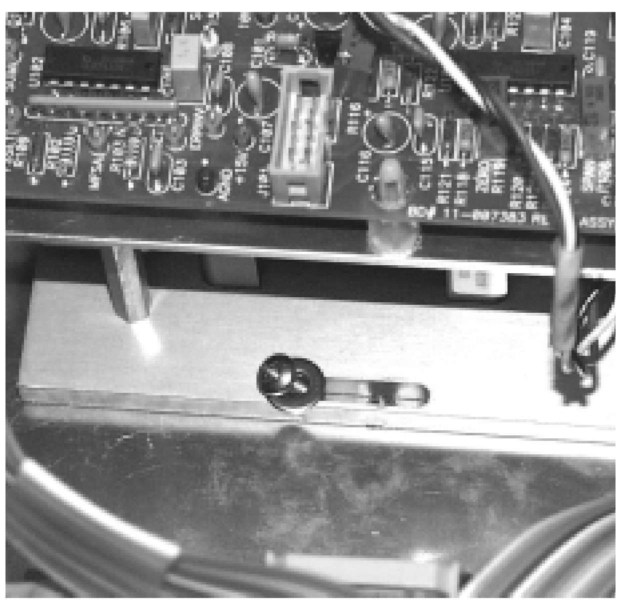


Figure 2-37 (left). New mass flow controllers assembly installed in control unit with screw in slot.

Figure 2-38 (right). Tightening the screw.

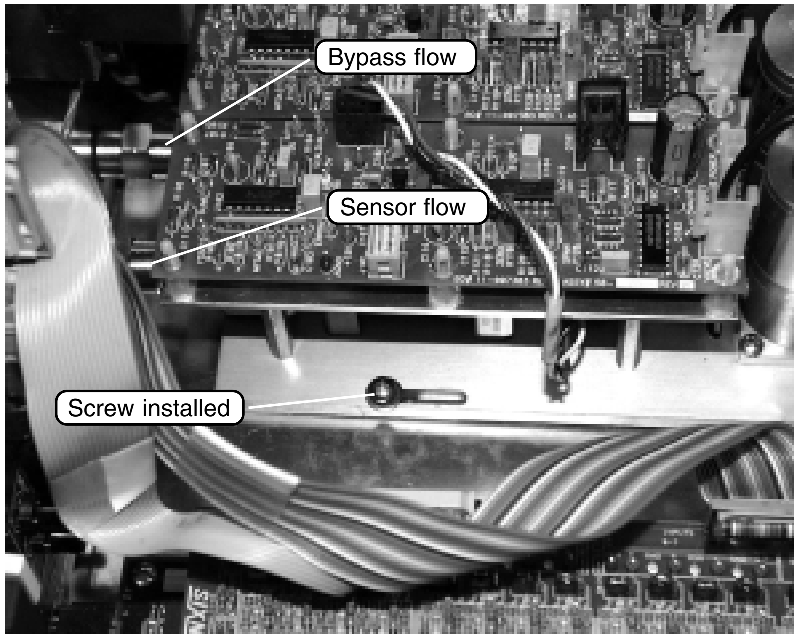


Figure 2-39. New mass flow controllers assembly installed in control unit with bypass flow, sensor flow and screw highlighted.

5) Install the SENSOR FLOW and BYPASS FLOW elbow connections (Figure 2-40). Secure the fittings that are attached to the mass flow controllers assembly (inside the control unit) with a wrench (Figure 2-41) while tightening the elbow connections. If the fittings that are attached to the mass flow controllers assembly twist while you are tightening the elbow connections, the internal O-rings will require 24 hours to completely reseal.

Figure 2-40. SENSOR FLOW and BYPASS FLOW elbow connectors installed on the back of the control unit.

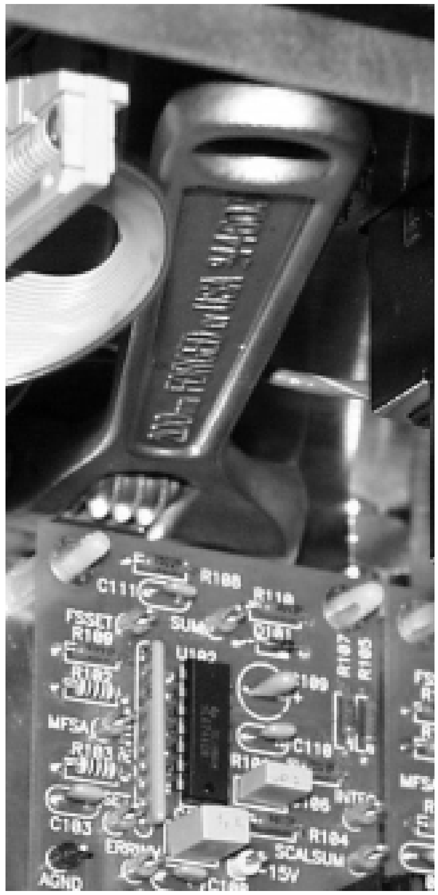


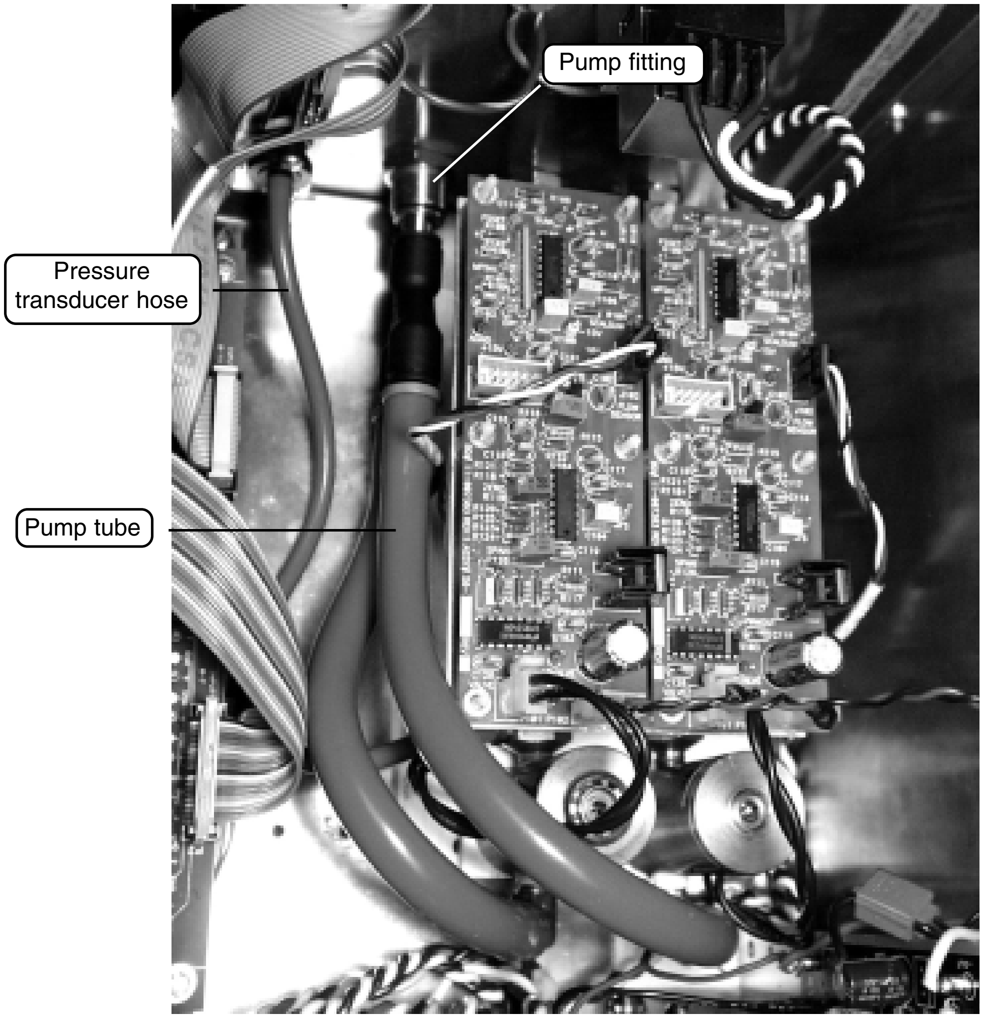
Figure 2-41. Using a wrench inside the control unit to secure an elbow fitting tight.

6) Install the pressure transducer hose (that was removed from the original mass flow controllers) onto the new mass flow controllers assembly (Figures 2-42, 2-43 and 2-44).

Figure 2-42 (left). Pressure transducer hose connected to the pressure transducer on the main interface board.

Figure 2-43 (right). Pressure transducer hose connected to the hose fitting on the new mass flow controllers assembly.

Figure 2-44. New mass flow controllers assembly installed in the control unit with pump tube, pump fitting and pressure transducer hose highlighted.



7) Install the pump tube onto the pump fitting located at the back of the control unit (Figure 2-44).

8) Install the red and black power wires that were spliced into the power supply onto the valve power connections on each board (Figures 2-45 and 2-46).

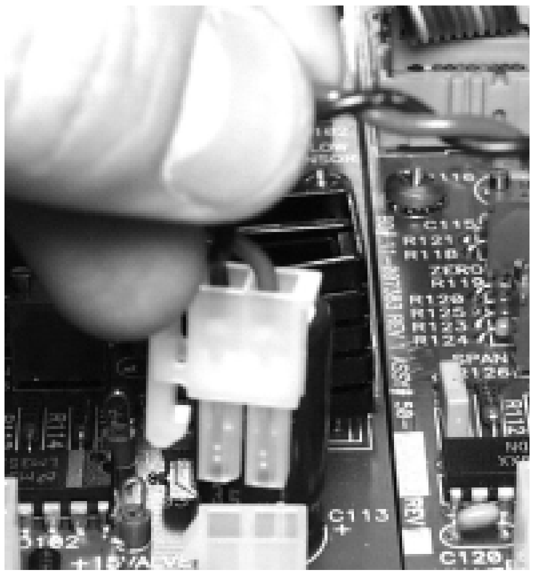


Figure 2-45. Installing valve power connectors.

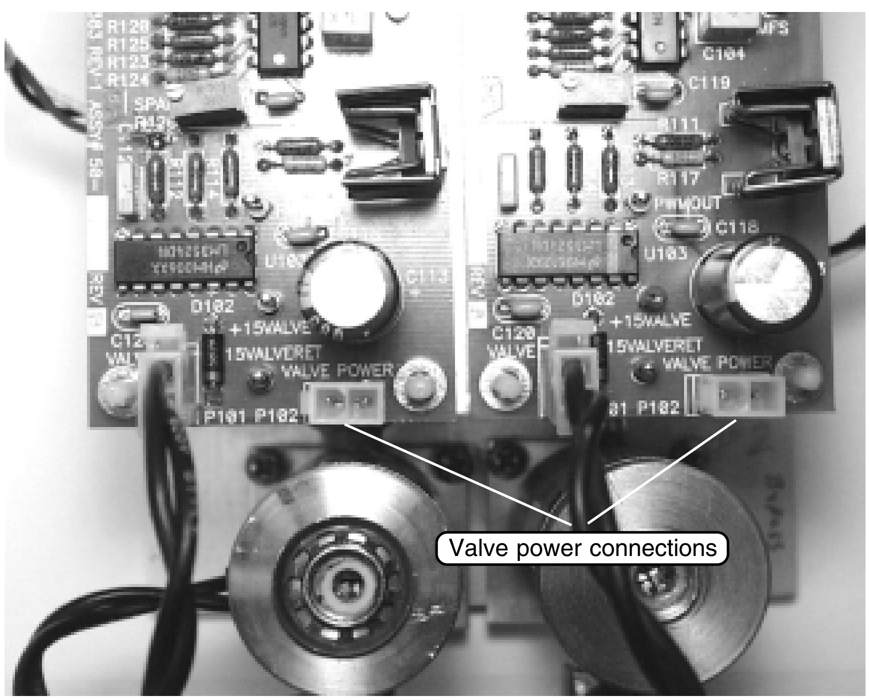


Figure 2-46. Top view of new flow controller with valve power connections highlighted.

9) Install the wiring harness cable connector onto the bottom wiring harness on the interface board (Figures 2-22, 2-23, 2-24 and 2-47).

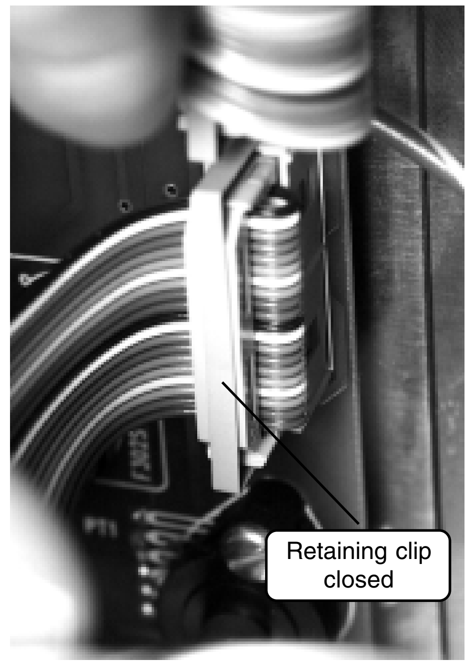


Figure 2-47 (left). Installing the wiring harness cable connector onto the interface board.

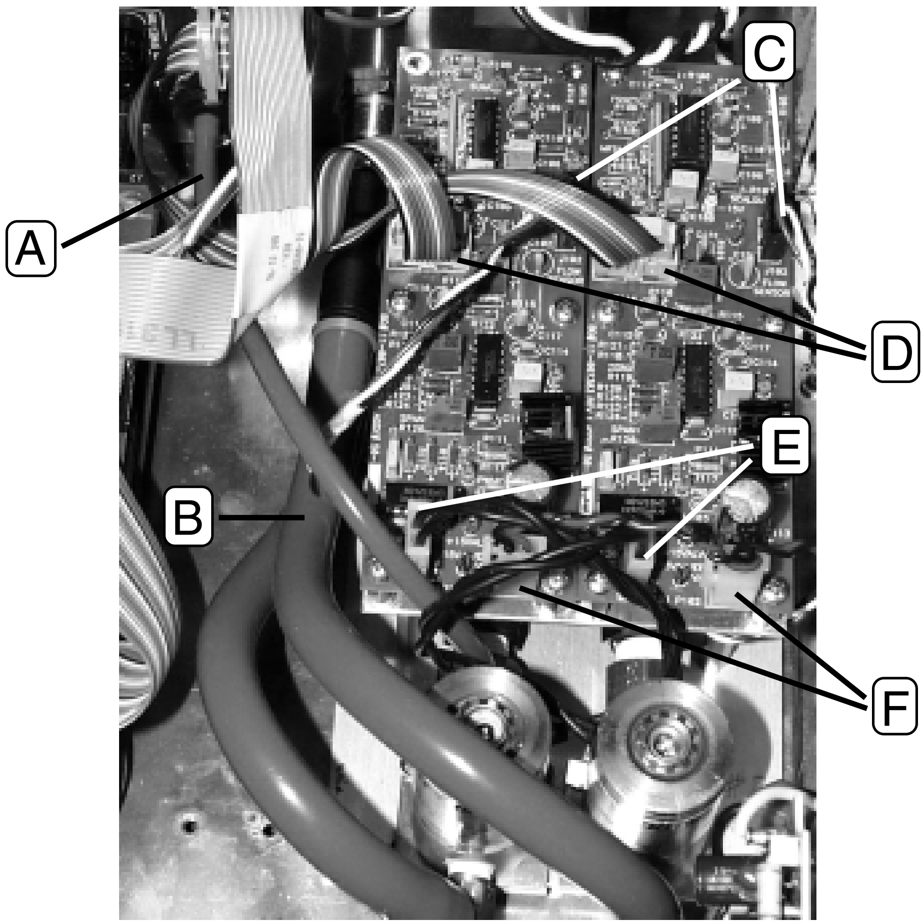
Figure 2-48 (right). Closing the retaining clip.

10) Close the retaining clip (Figures 2-47 and 2-48). Retaining clips are pieces of thin flexible metal used to secure the cable connectors to the electronics board.

NOTE: If you remove the wiring harness cable connector from the mass flow controllers assembly, note that one ribbon arm is longer than the other so that the harness fits one way only. When installing the wiring harness cable connector, attach the "short" side of the cable connector to the mass flow controllers assembly board that is closest to the interface board.

11) Check the connections (Figure 2-49).

Figure 2-49. New flow controller with pressure transducer tubing (A), pump tubing (B), flow sensor connections (C), wiring harness connections (D), valve connections (E), and valve power connections (F) highlighted.



12) The new mass flow controllers that are shipped directly from R&P are already calibrated. However, R&P recommends that you check the calibration of the new mass flow controllers (Service Manual, Section 3).

13) Install the top cover onto the control unit.

14) Return the unit to its normal operating configuration.

2.4. Installing the Control and Sensor Units

The control unit can be located at any convenient location such as a laboratory bench that is within 20 meters of the sensor unit (the default cable length is 10 m). R&P recommends that the sample line be as short as possible for best results. Consult R&P when the distance between these units is longer than 20 meters. The sensor unit should be located directly below the inlet point of the sample stream on a sturdy surface.

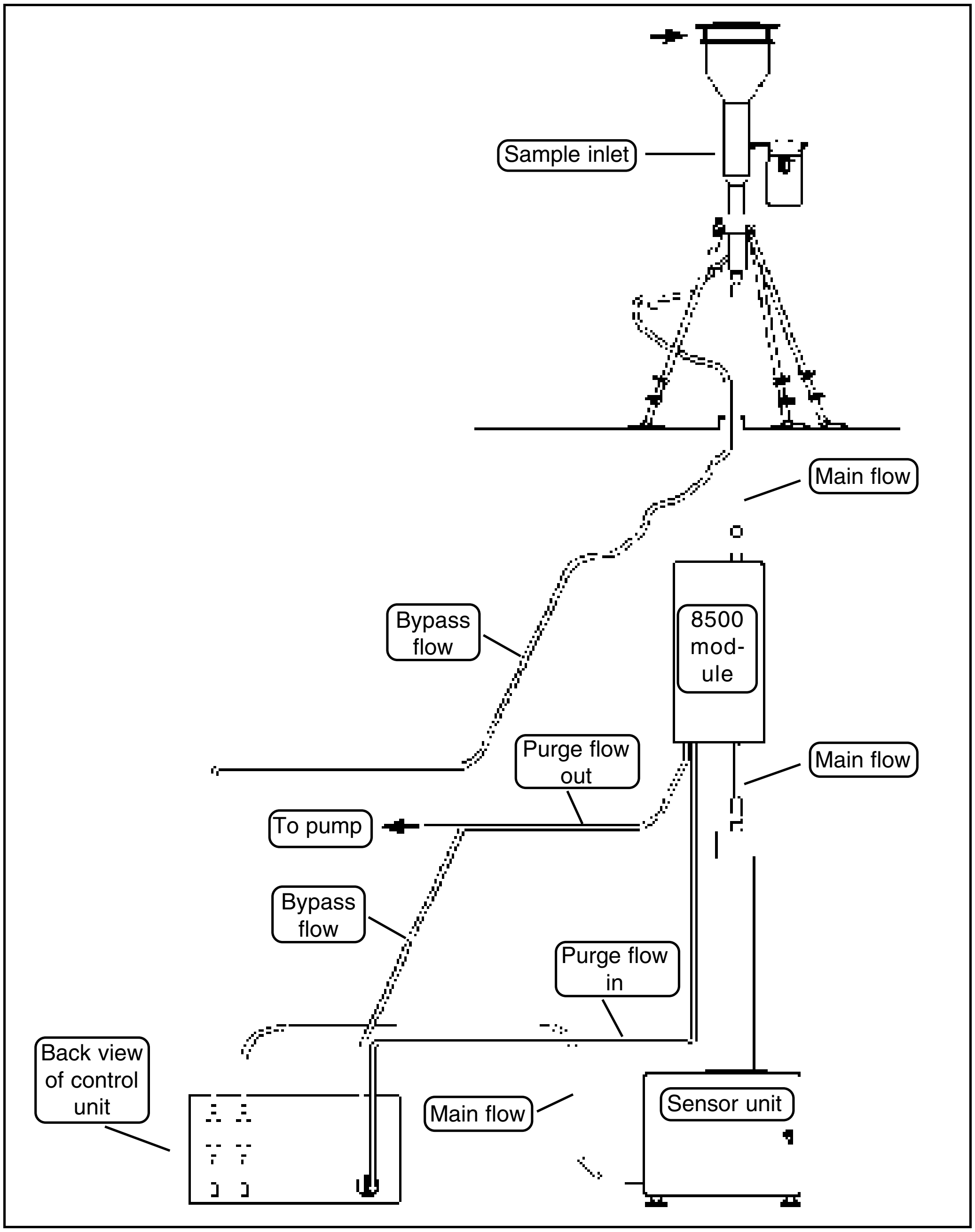


Figure 2-50. Schematic diagram of a typical installation.

2.4.1. Voltage Setting

Follow these steps to set the proper voltage for your installation:

1) Locate the voltage setting indicator on the power line filter on the back panel of the control unit (Figures 2-51 and 2-52).

Figure 2-51. Power line filter with voltage setting indicator (A) highlighted.

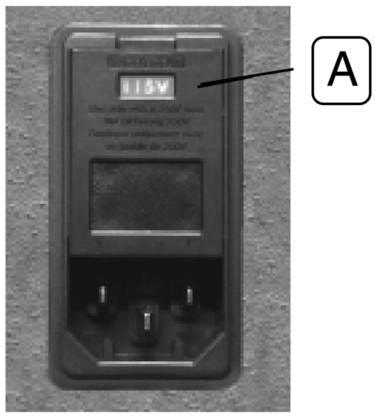
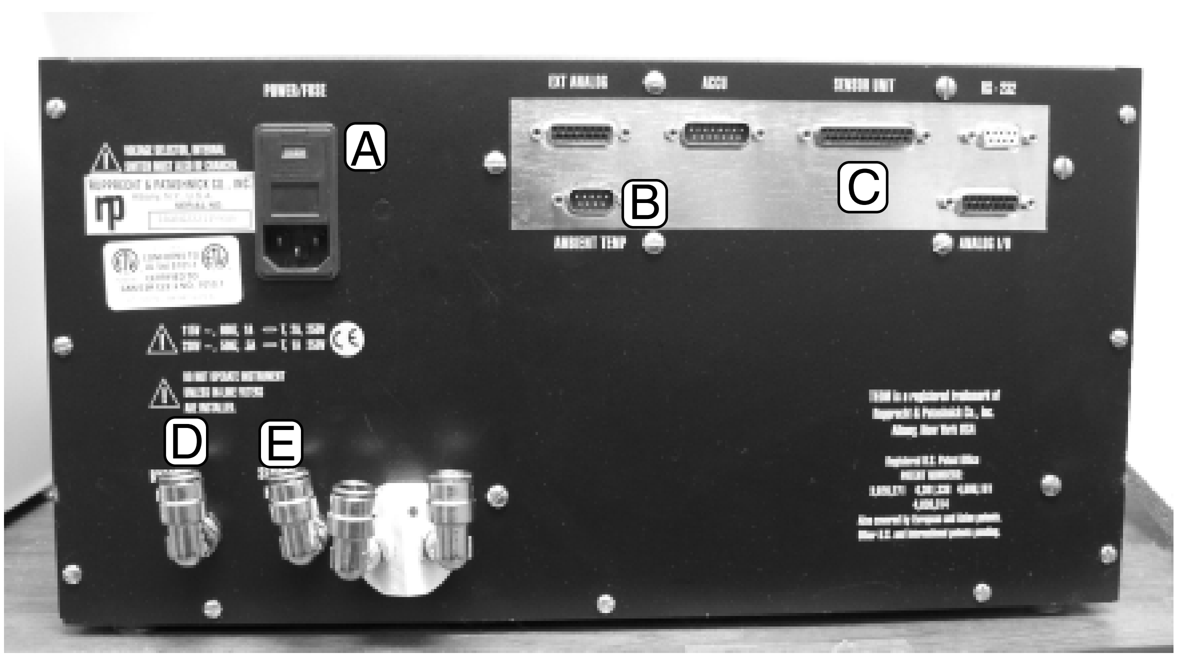


Figure 2-52. Back panel of control unit with the fuse/ power cord socket and power line filter (A), ambient temperature sensor connector (B), 25-pin electrical connection to sensor unit (C), bypass flow connection (D) and sensor flow connection (E) highlighted.

2) Consult a licensed electrician if you are uncertain of the electrical requirements in your area. If the voltage setting is appropriate for your installation, go to step 8. If the voltage setting is not appropriate for your installation, go to step 3.



3) Place the blade of a small slotted screwdriver in the slot on top of the fuse/power cord socket and power line filter (Figure 2-53) and open the cover.

Figure 2-53. Opening the cover of the fuse/power cord socket and power line filter with a screwdriver.

4) Place the blade of a small slotted screwdriver in the top of the fuse holder insert. Remove the insert by sliding it out of the power line filter (Figure 2-54).

Figure 2-54. Removing the fuse insert with the screwdriver.

5) **Remove the two fuses from the insert (Figures 2-55 and 2-56).**

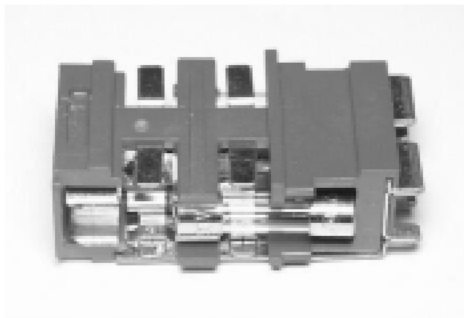


Figure 2-55. Close up of the fuse holder insert with a fuse installed.

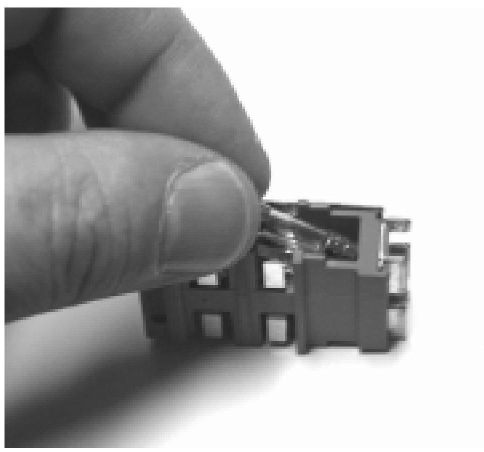


Figure 2-56. Removing the fuses from the fuse holder insert.

6) **Install the proper fuses into the insert. Use 2A fuses for 115 VAC operation, or 1A fuses for 230 VAC operation.**

7) Install the insert into the power line filter (Figure 2-57) and close the cover (Figure 2-58) so that you can read the correct voltage in the window (Figure 2-59).

Figure 2-57 (left). Installing the fuse insert into the fuse/ power cord socket and power line filter.

Figure 2-58 (right). Closing the cover on the power line filter.

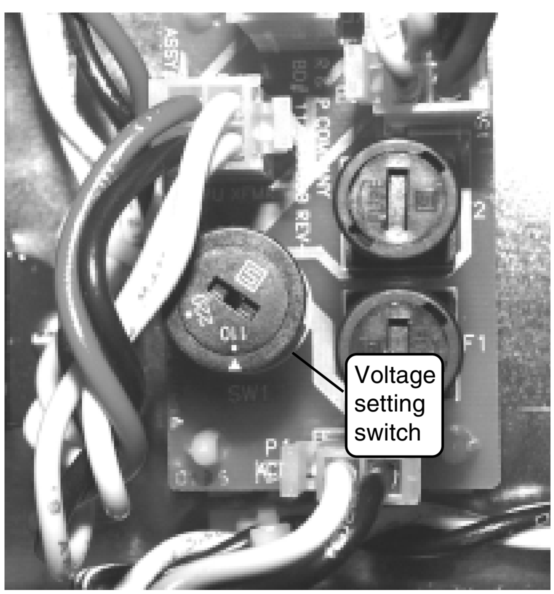
Figure 2-59. The power line filter with the correct voltage (A) highlighted.

8) Remove the top cover of the control unit by unscrewing the screws holding the top cover plate in place (Figure 2-60).

Figure 2-60. Top cover of the control unit removed.

9) **Locate the voltage setting switch (Figure 2-61) near the center of the control unit.**

Figure 2-61. Location of the voltage setting switch.



10) **Insert a slotted screwdriver into the slot on the top of the voltage setting switch (Figure 2-61) and turn the switch to the correct voltage setting.**

11) **Replace the cover of the control unit.**

12) **Locate one of the power cords.**

13) **Insert the power cord into the fuse/power cord socket (Figure 2-51).**

14) **You must now assemble the 8500 module brace (Section 2.4.2).**

2.4.2. 8500 Module Brace

If you will be installing the 8500 module in a location where you will NOT have access to the back of the module and its flow connections, such as in an outdoor enclosure, refer to Appendix K.

Follow these steps to install the 8500 module brace:

1) Locate the 8500 module brace base and stand (Figure 2-62).

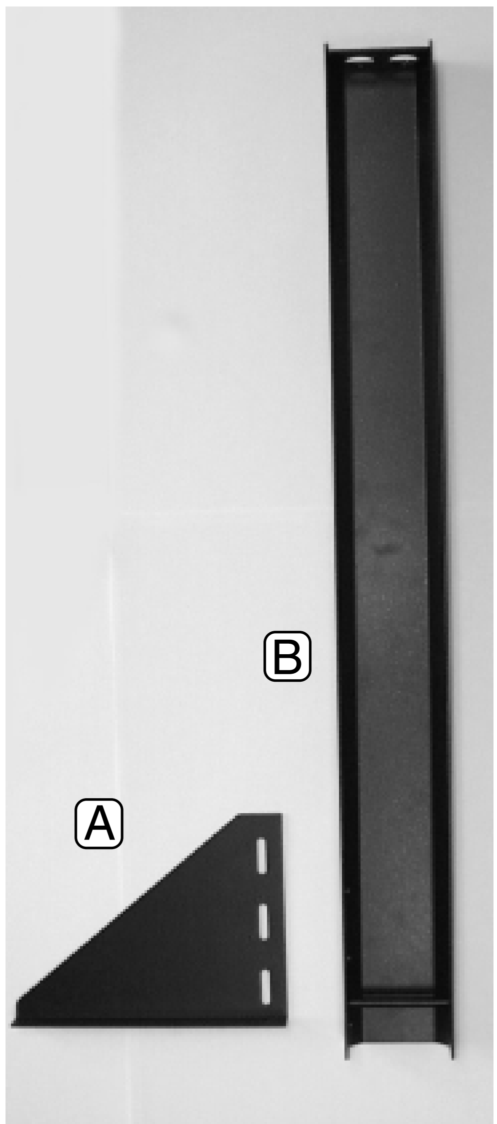


Figure 2-62. 8500 module brace base (A) and stand (B).

2) Install brace base onto the brace stand with the brace stand channel facing AWAY from the base using the three 10/32 x 5/8 screws (Figures 2-63 and 2-64).

Figure 2-63. Installing the brace base onto the brace stand.

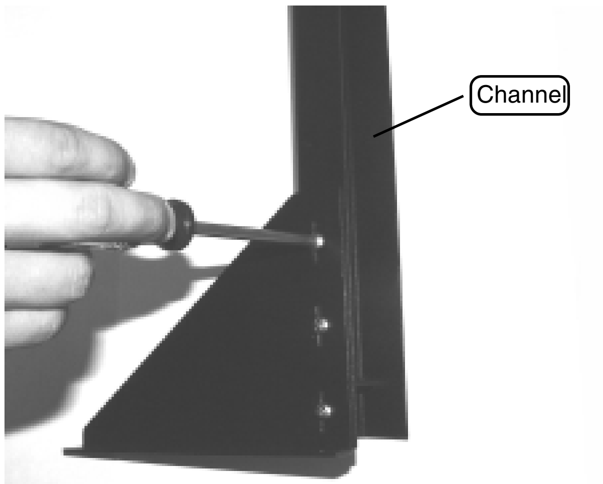


Figure 2-64. 8500C module brace.

3) **Locate the four screws on top of the sensor unit that secure the sample inlet (Figure 2-65).**

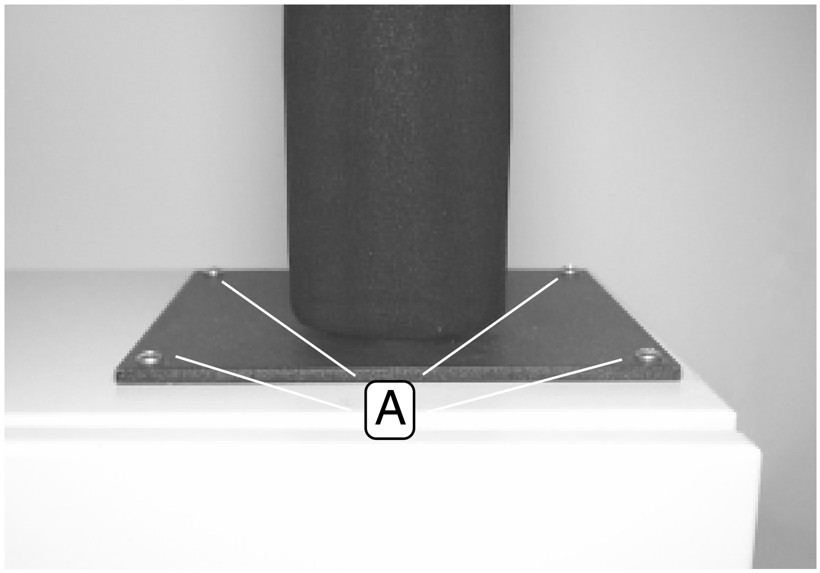


Figure 2-65. Top of sensor unit with sample inlet mounting screws highlighted.

4) **Remove the two mounting screws located on the left-hand side of the sample inlet (Figure 2-66).**

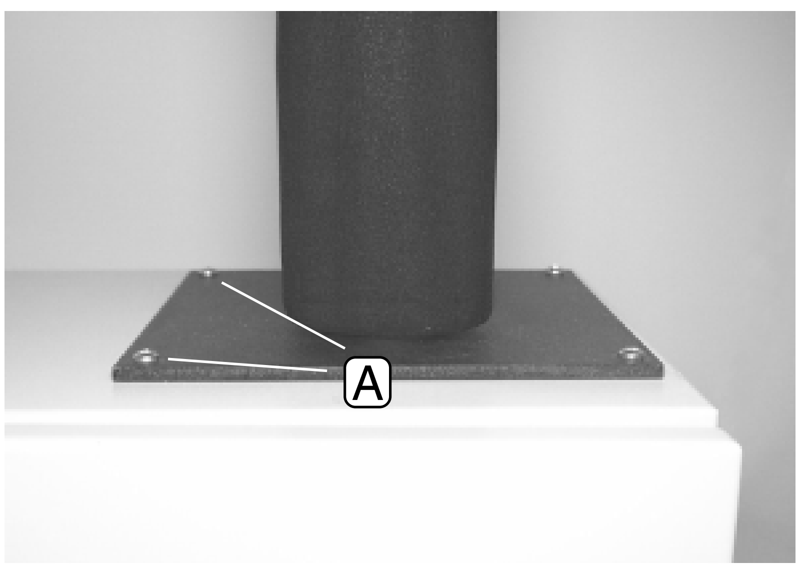


Figure 2-66. Top of sensor unit with 2 left-hand sample inlet mounting screws highlighted.

5) Install the brace onto the top of the sensor unit using the two screws that you removed in step 4 (Figures 2-67 and 2-68).

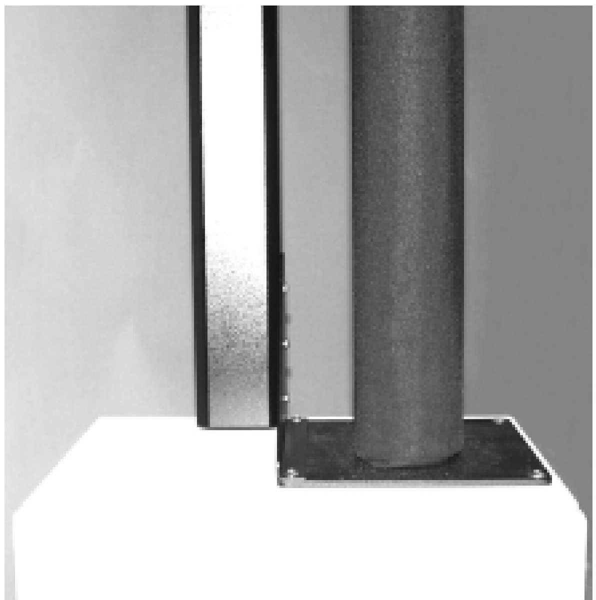


Figure 2-67. Brace mounted on sensor unit.

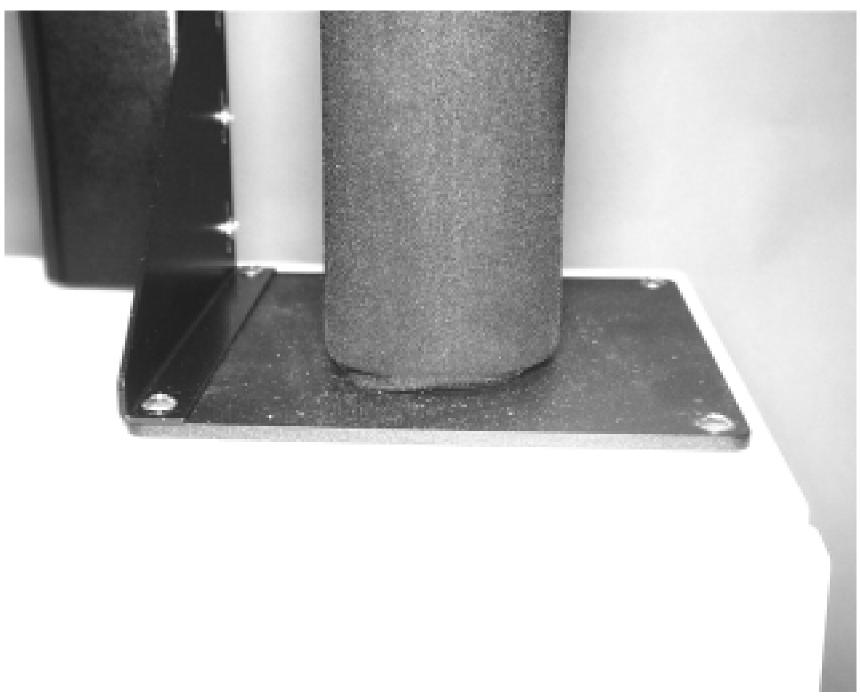


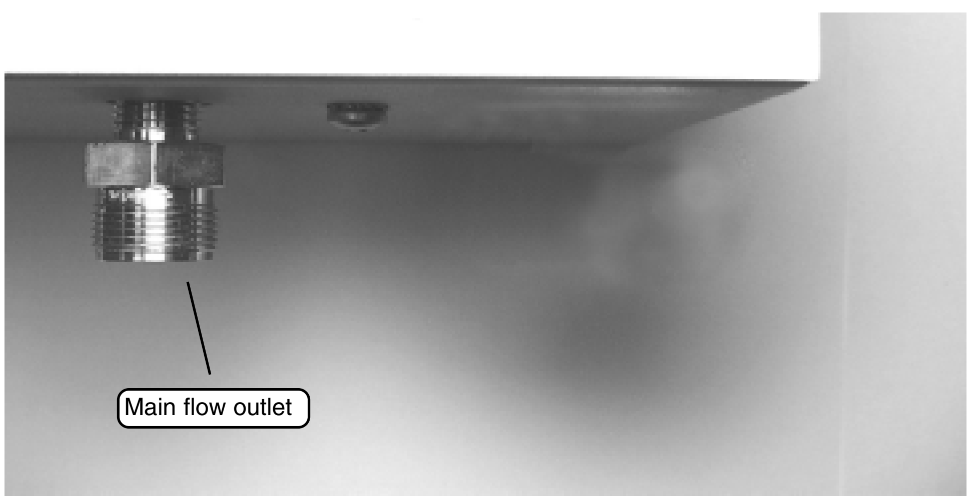
Figure 2-68. Close-up view of brace mounted on sensor unit.

6) Locate the 8500 module (Figure 2-69).

Figure 2-69. 8500 module.

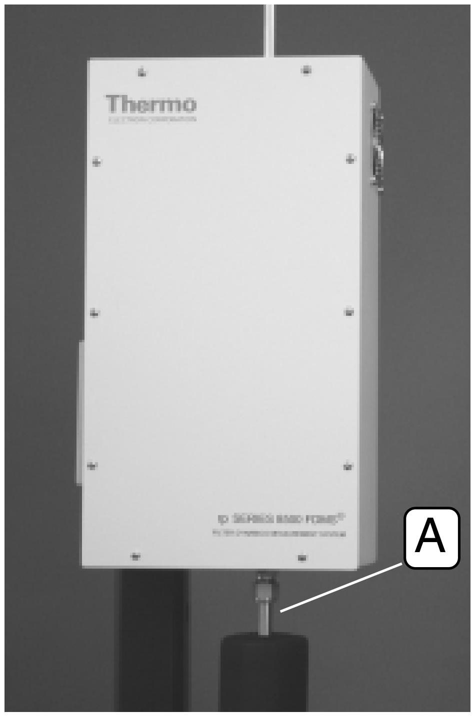
7) Locate the main flow outlet port on the bottom, right-hand corner of the 8500 module (Figure 2-70).

Figure 2-70. Close-up view of main flow outlet on the 8500 module.



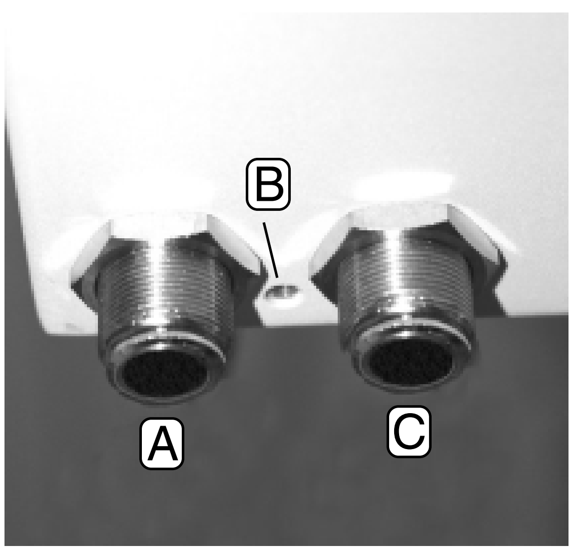
8) Install the 8500 module's main flow outlet port onto the sample inlet of the sensor unit (Figure 2-71). Be sure to tighten the Swagelok fitting 1-1/4 turn past finger-tight with a wrench.

Figure 2-71. 8500C module's main flow outlet port installed onto sample inlet of sensor unit (A).



9) Locate the purge flow inlet and outlet ports and the set screw hole on the bottom, left-hand corner of the 8500 module (Fig. 2-72).

Figure 2-72. Close-up view of the purge flow outlet port (A), set screw hole (B) and purge flow inlet port (C) on the bottom, left-hand corner of the 8500C module.



10) Install the purge flow inlet and outlet ports into the top of the brace (Figure 2-73).

Figure 2-73. Purge flow inlet and outlet ports installed into the top of the brace.

11) Locate the set screw for the 8500 module brace (Section 2.2).

12) Install the set screw into the hole in the top of the brace (Figures 2-73 and 2-74).

NOTE: There are two holes in the top of the brace. Install the set screw into the hole that is located near the back of the 8500 module.

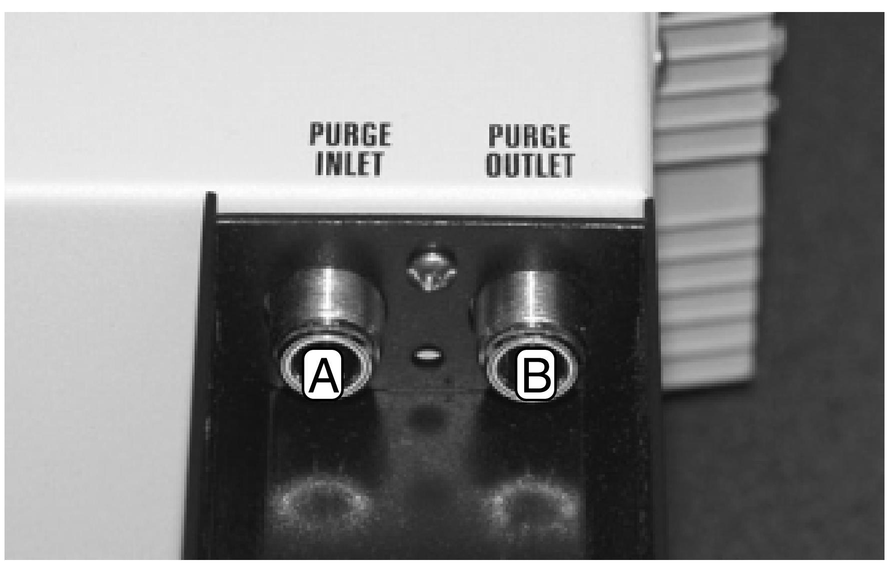


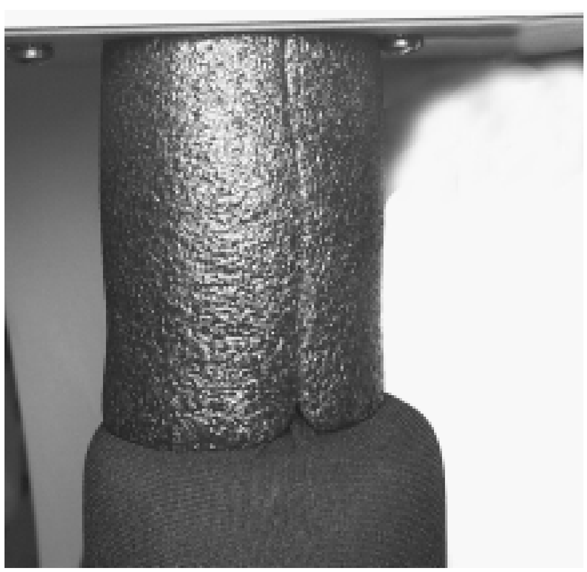
Figure 2-74. Set screw installed into the 8500 module near the purge flow inlet port (A) and the purge flow outlet port (B).

13) Locate the 3-inch insulation sleeve (Figure 2-75).

Figure 2-75. 3-inch insulation sleeve.

14) Install the insulation sleeve onto the exposed sample inlet between the sensor unit and 8500 module (Figure 2-76).

Figure 2-76. 3-inch insulation sleeve installed onto the exposed sample inlet.



15) You must now assemble the control unit connections (Section 2.4.3).

2.4.3. Control Unit Connections

2.4.3.1. Main Flow Connections

Follow these steps to assemble the main flow connections:

1) **Locate the 3/8-inch nylon green tubing (Section 2.2).**
2) **Cut a 13 cm (5-inch) length of the nylon green tubing (Figure 2-77). Ensure that the cut in the tubing is clean and perpendicular.**

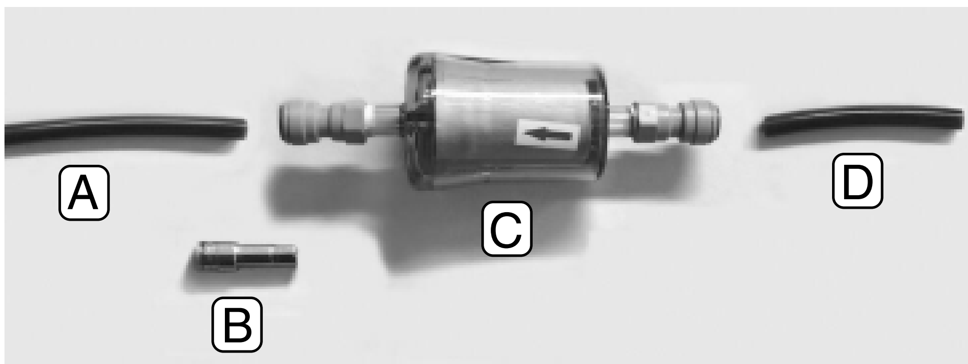


Figure 2-77. Main flow components with parts disassembled: 1/4-inch black flow line tubing (A), 3/8-inch to 1/4-inch reducer fitting (B), large in-line filter (C) and 3/8-inch green flow line tubing (D).

3) **Push one end of the cut piece of the 3/8-inch nylon green tubing into the "SENSOR FLOW" port located on the back, left-hand corner of the control unit (Figure 2-78).**

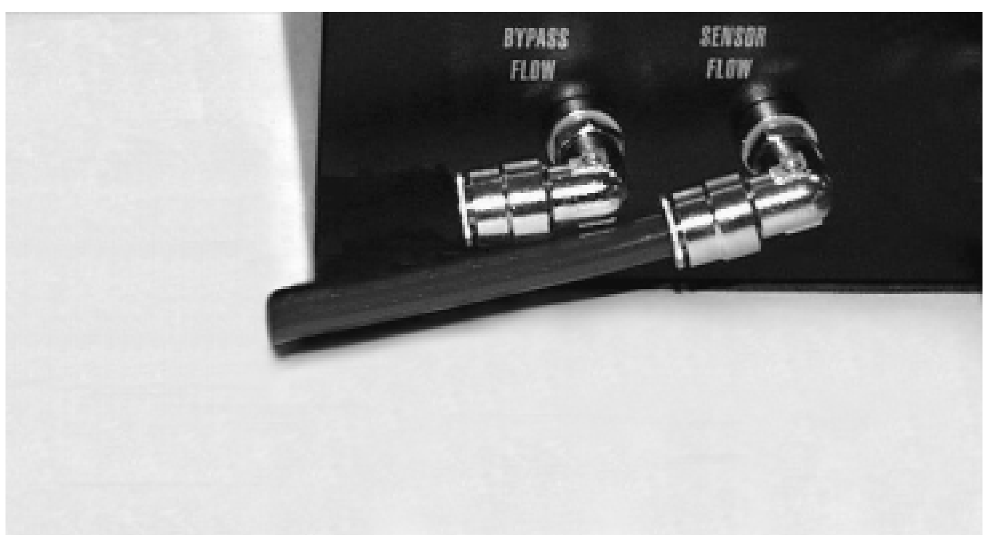


Figure 2-78. 3/8-inch flow line tubing inserted into the "SENSOR FLOW" port.

NOTE: The Series 8500 FDMS Monitor uses push-to-connect fittings for all air lines. To engage these connections, the air tube must be pushed completely into the fitting so that the tube is fully inserted and cannot be pulled out. While pushing the tubing into the fitting, there is an intermediate stop at an O-ring. You must push the tubing past the O-ring to completely engage the tubing inside the fitting and prevent air leaks. To disengage the connection, push the small collar (located at the end of the fitting) toward the fitting and pull the tube out.

4) Locate one of the large in-line filters (Figure 2-79).

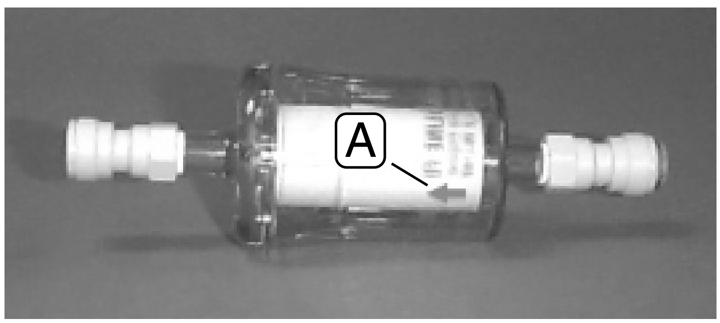


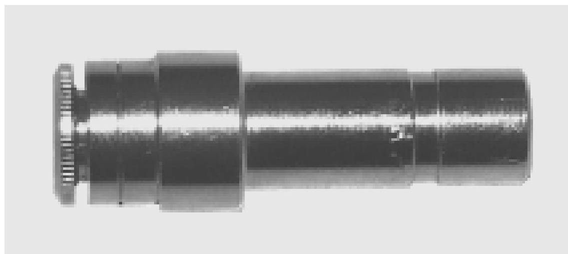
Figure 2-79. Large in-line filter with the flow arrow (A) highlighted.

5) Push the filter onto the open end of the 3/8-inch nylon green tubing so that the flow arrow on the filter points *away* from the control unit (Figure 2-80).

Figure 2-80. Large in-line filter connected to the 3/8-inch flow line tubing on the sensor flow fitting. Note that the flow arrow (A) on the filter points *away* from the control unit.

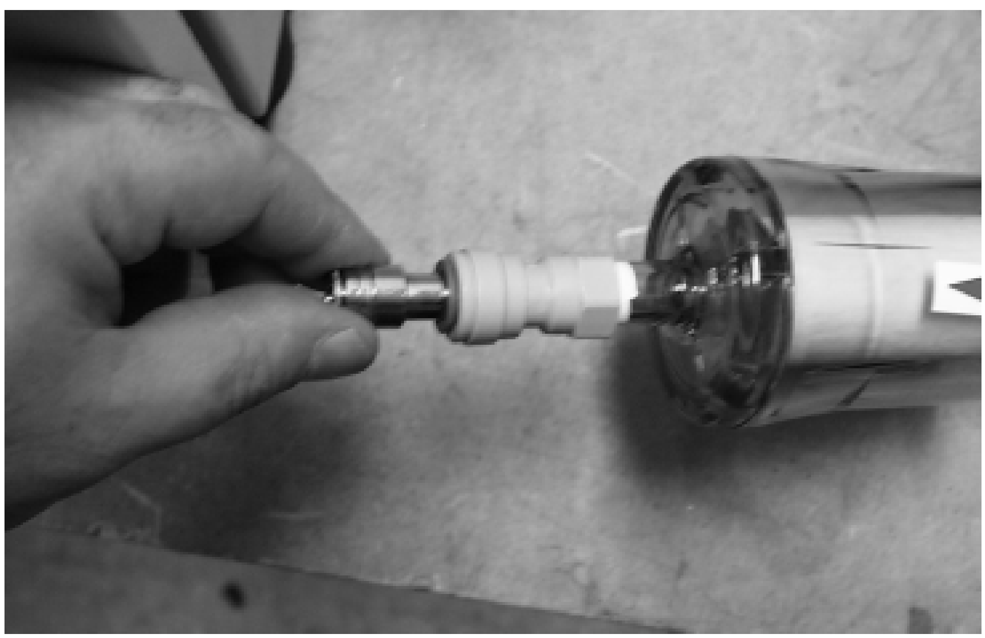
6) Locate the 3/8-inch to 1/4-inch reducer fitting (Figure 2-81).

Figure 2-81. 3/8-inch to 1/4-inch reducer fitting.



7) Insert the 3/8-inch end of the reducer fitting into the large in-line filter (Figure 2-82).

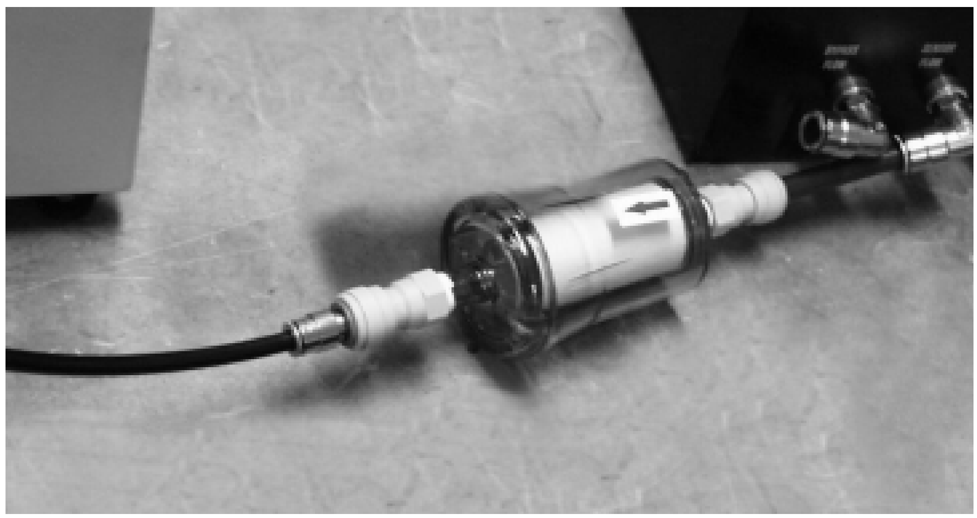
Figure 2-82. Reducer fitting inserted into the large in-line filter.



8) Locate the electric- and air-connecting cable (Section 2.2).

9) Install the 1/4-inch black tubing of the electric- and air-connecting cable into the reducer fitting (Figure 2-83).

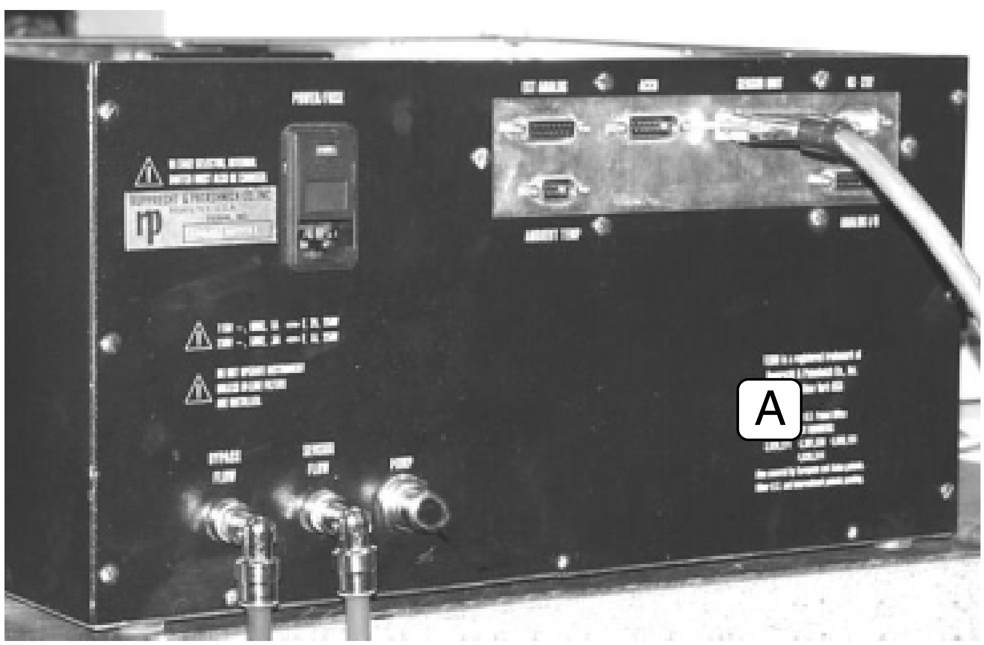
Figure 2-83. 1/4-inch black tubing installed in the reducer fitting.



10) Install the electrical connector (Figure 2-84) of the electric- and air-connecting cable into the “SENSOR UNIT” connection port (Figure 2-85) on the back of the control unit.

Figure 2-84. One of the electrical connectors of the electric- and air-connecting cable.

Figure 2-85. Back view of control unit with the electric- and air-connecting cable installed into the “SENSOR UNIT” connection port (A).



NOTE: The other ends of the electric- and air-connecting cable will be connected when you install the sensor unit (Section 2.4.6).

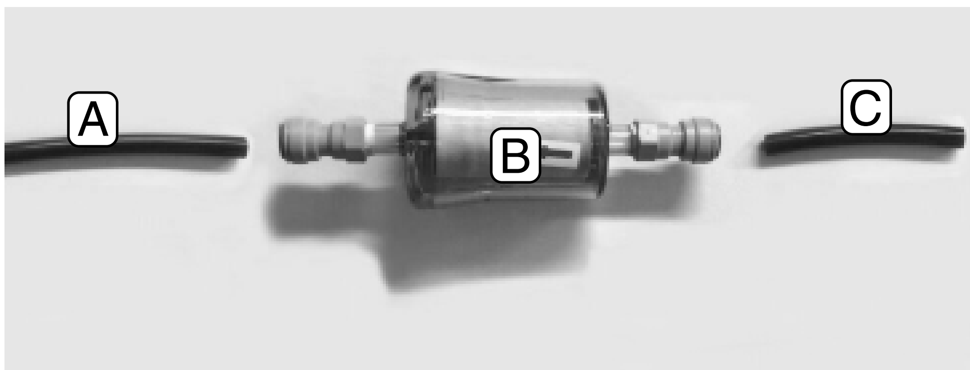
11) You must now assemble the bypass flow connections (Section 2.4.3.2).

2.4.3.2. Bypass Flow Connections

Follow these steps to assemble the bypass flow connections:

1) **Locate the 3/8-inch nylon green tubing.**
2) **Cut a length of the 3/8-inch nylon green tubing approximately 13 cm (5 inches) long (Figure 2-86). Ensure that the cut in the tubing is clean and perpendicular.**

Figure 2-86. Bypass flow components with parts disassembled: 3/8-inch flow line tubing (A), large bypass in-line filter (B), and 3/8-inch flow line tubing (C).



3) **Push the 13 cm (5-inch) length of tubing into the fitting on the back of the control unit labeled "BYPASS FLOW" (Figure 2-87).**

Figure 2-87. 3/8-inch green nylon tubing inserted into the "BYPASS FLOW" port on the back of the control unit.

4) **Locate another large in-line filter (Figure 2-79).**

NOTE: The Series 8500 FDMS Monitor uses push-to-connect fittings for all air lines. To engage these connections, the air tube must be pushed completely into the fitting so that the tube is fully inserted and cannot be pulled out. While pushing the tubing into the fitting, there is an intermediate stop at an O-ring. You must push the tubing past the O-ring to completely engage the tubing inside the fitting and prevent air leaks. To disengage the connection, push the small collar (located at the end of the fitting) toward the fitting and pull the tube out.

5) Push the filter onto the open end of the length of 3/8-inch green tubing so that the flow arrow on the filter points *away* from the control unit (Figure 2-88).

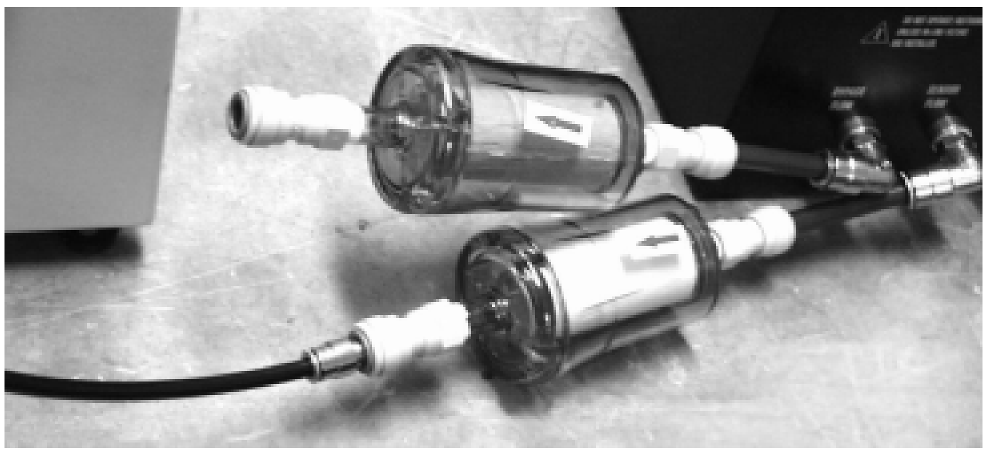


Figure 2-88. Large in-line filter inserted into the 3/8-inch nylon green bypass flow tubing.

6) Locate the 3/8-inch nylon green tubing.

7) Cut a length of the 3/8-inch nylon green tubing long enough to reach between the control unit and the sample pump. Ensure that the cut in the tubing is clean and perpendicular.

8) Insert one end of the green tubing into the bypass pump port on the dual-flow fitting, on the back of the control unit (Figure 2-89).

NOTE: The bypass pump port of the dual-flow fitting is the one NOT marked with a dimple.

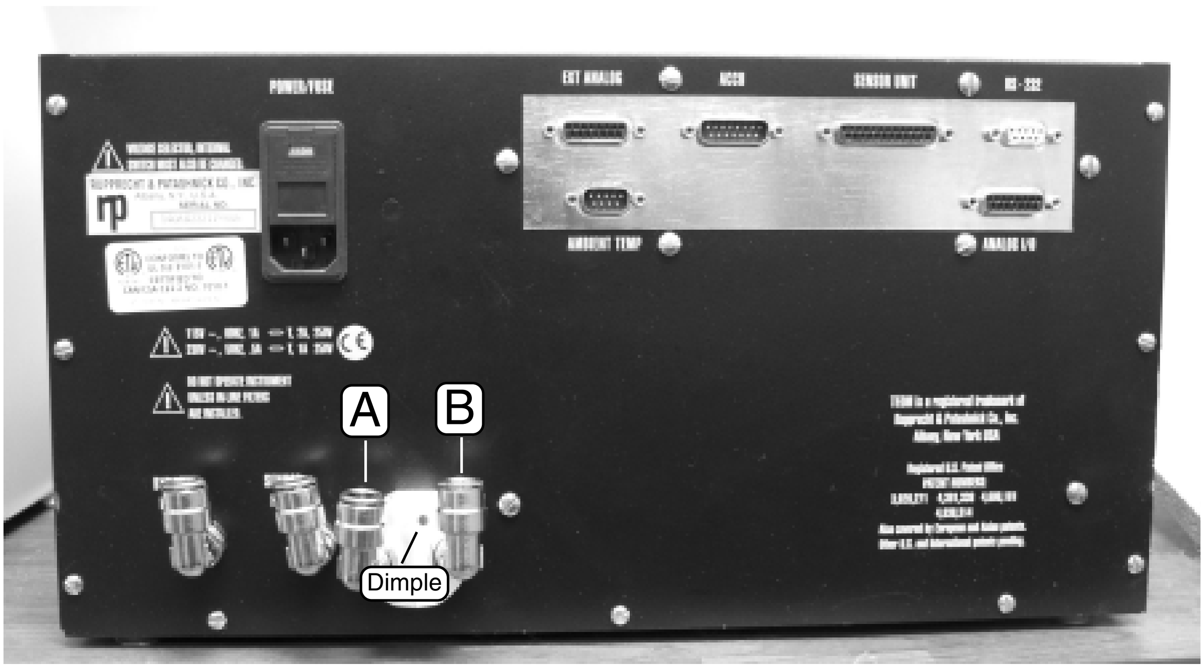


Figure 2-89. Back of control unit with the bypass pump port (A) and the main flow port (B) highlighted.

9) Cut a 2-inch length of the 3/8-inch nylon green tubing. Ensure that the cut in the tubing is clean and perpendicular.

NOTE: You may use an extra piece of 3/8-inch nylon green tubing (of any length) if one is available, instead of cutting this short length.

10) Install the 3/8-inch nylon green tubing into the sample pump.

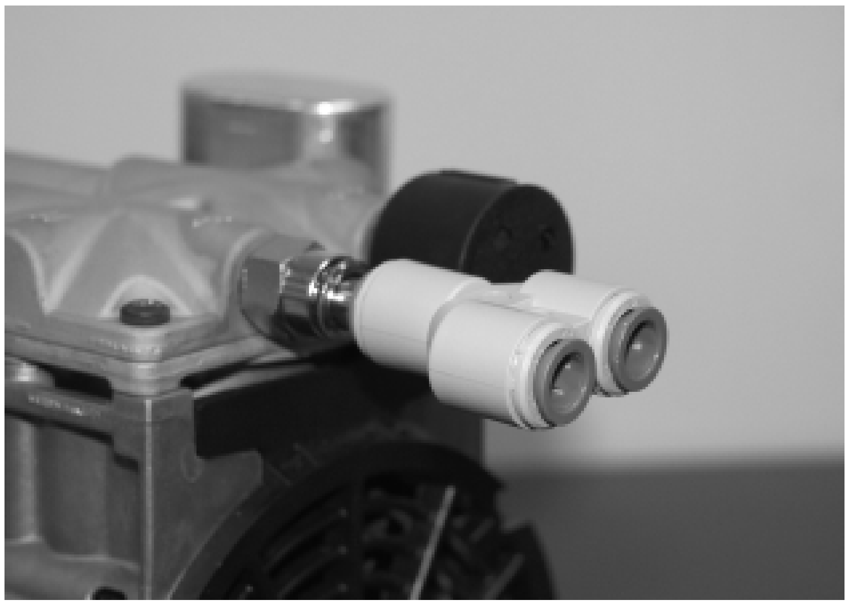
11) Locate the Y-fitting (Section 2.2).

NOTE: If you converted your control unit from an 1400 control unit to an 8500 control unit (Section 2.3), you may use the Y-fitting that you removed from the control unit.

12) Install the single port of the Y-fitting onto the short length of the 3/8-inch nylon green tubing (Figure 2-90).

NOTE: You may install the Y-fitting near the pump (Figures 2-90 and 2-91) or near the control unit to conserve tubing.

Figure 2-90. Y-fitting installed on the sample pump.



13) Install the other end of the green tubing that is attached to the bypass pump fitting (in the dual flow fitting on the back of the control unit) into the Y-fitting on the pump (Figure 2-91).

Figure 2-91. Green tubing installed into the Y-fitting on the sample pump.

14) You must now install the 8500 module (Section 2.4.4).

2.4.4. 8500 Module Installation

Follow these steps to install the 8500 module:

1) Locate the 8500 module (Figure 2-92).

Figure 2-92. 8500 module.

2) Locate the 3/8-inch green nylon tubing (Section 2.2).

3) Cut a length of 3/8-inch nylon green tubing that will reach between the 8500 module and the control unit. Ensure that the cut in the tubing is clean and perpendicular.

4) Insert one end of the cut tubing into the "PURGE INLET" port on of the 8500 module (Figure 2-93).

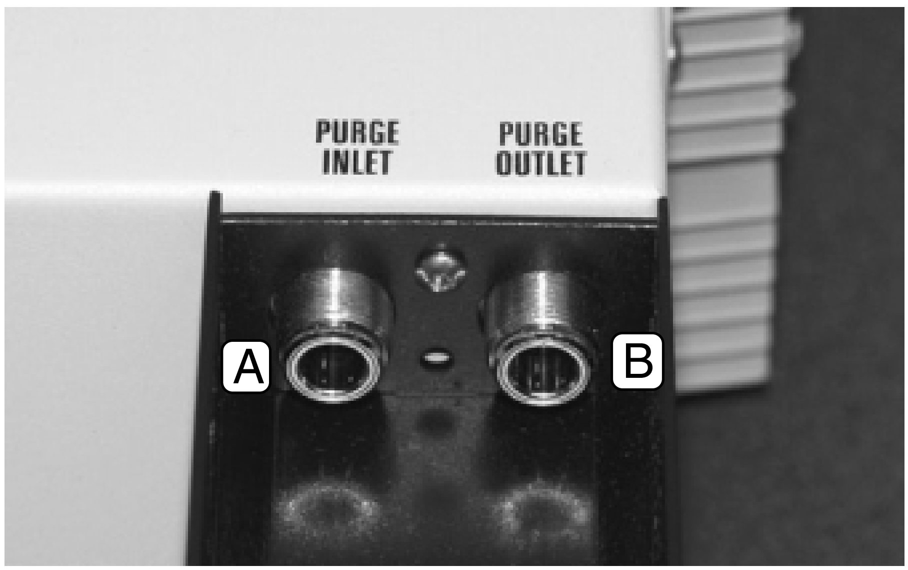


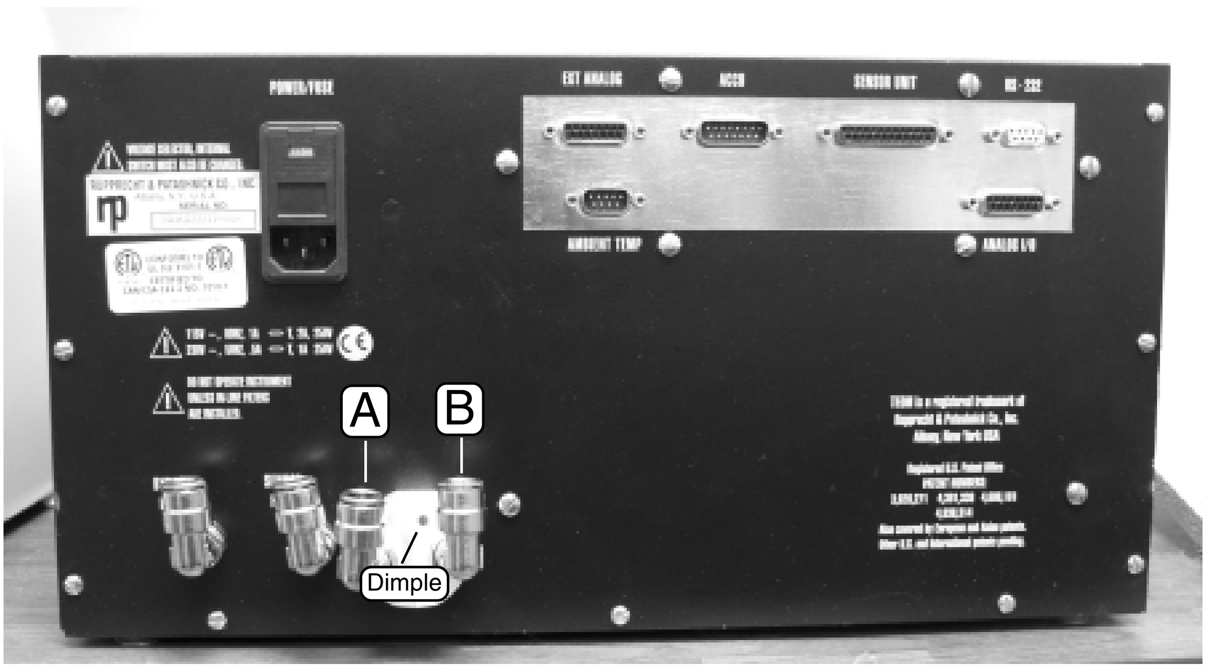
Figure 2-93. Close-up view of the PURGE INLET port (A) and PURGE OUTLET port (B) connections on the bottom, right-hand corner of the 8500 module when viewed from the BACK of the 8500 module.

NOTE: The Series 8500 FDMS Monitor uses push-to-connect fittings for all air lines. To engage these connections, the air tube must be pushed completely into the fitting so that the tube is fully inserted and cannot be pulled out. While pushing the tubing into the fitting, there is an intermediate stop at an O-ring. You must push the tubing past the O-ring to completely engage the tubing inside the fitting and prevent air leaks. To disengage the connection, push the small collar (located at the end of the fitting) toward the fitting and pull the tube out.

5) Install the other end of the cut green tubing into the main flow port on the dual-flow fitting, on the back of the control unit (Figure 2-94).

NOTE: The main flow port of the dual-flow fitting is the one marked with a dimple.

Figure 2-94. Back of control unit with the bypass pump port (A) and the main flow port (B) highlighted.



6) Cut another length of the 3/8-inch nylon green tubing that will reach between the 8500 module and the pump. Ensure that the cut in the tubing is clean and perpendicular.

7) Install one end of the cut tubing into the "PURGE OUTLET" port of the 8500 module (Figure 2-93).

8) Install the other end of the cut tubing into the Y-fitting on the sample pump (Figure 2-95).

Figure 2-95. 3/8-inch nylon tubing installed in the pump Y-fitting.

8) You must now assemble the electrical connections (Section 2.4.5).

2.4.5. Electrical Connections

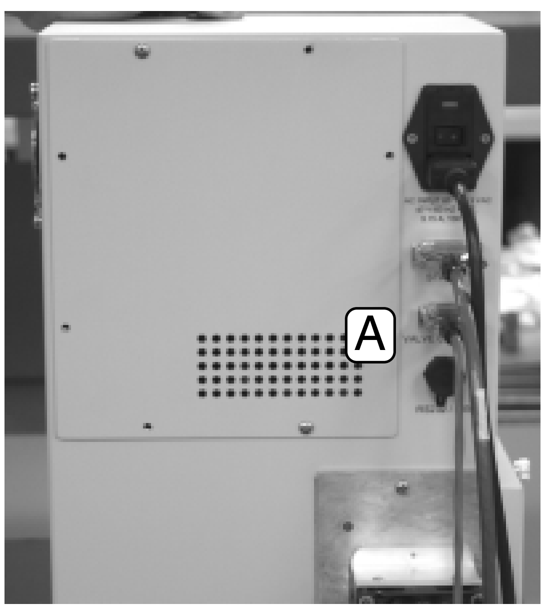
Follow these steps to assemble the electrical connections:

1) Locate the 9-to-15 pin valve signal cable (Figure 2-96).

Figure 2-96. 9-to-15 pin valve signal cable.

2) Install the 9-pin connector of the valve signal cable into the 9-pin "VALVE CONTROL" connection port on the back of the 8500 module (Figure 2-97).

Figure 2-97. Valve signal cable installed into the valve control port (A) on the back of the 8500C module.



3) Install the 15-pin connector of the valve signal cable into the 15-pin "ACCU" connection port on the back of the control unit (Figure 2-98).

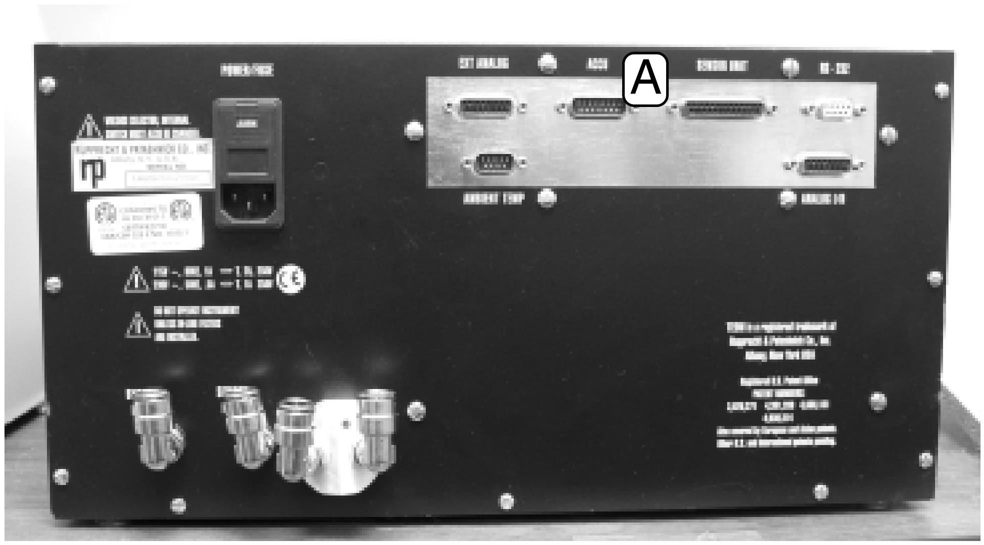


Figure 2-98. Back view of the control unit with the 15-pin ACCU connection port highlighted (A).

4) Locate the 15-to-15 pin data interface cable (Figure 2-99).

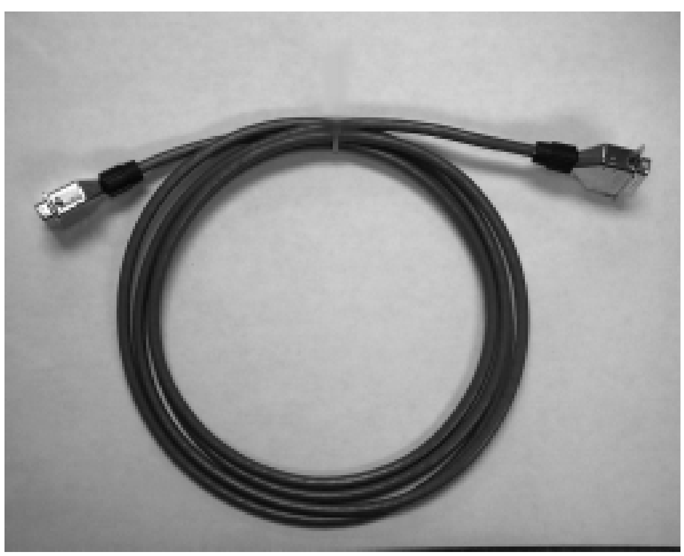


Figure 2-99. 15-to-15 pin data interface cable.

5) Install the 15-pin connector of the data interface cable into the 15-pin "STATUS" connection port on the back of the 8500 module (Figure 2-100).

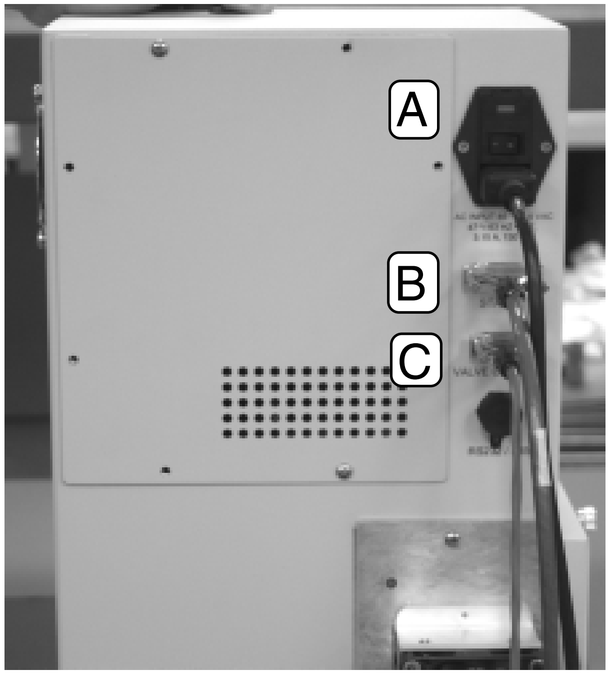


Figure 2-100. 8500 module with the power cord (A), data interface cable (B) and valve signal cable (C) installed on the back of the module.

6) Install the 15-pin connector of the data interface cable into the "EXT ANALOG" connection port on the back of the control unit (Figure 2-101).

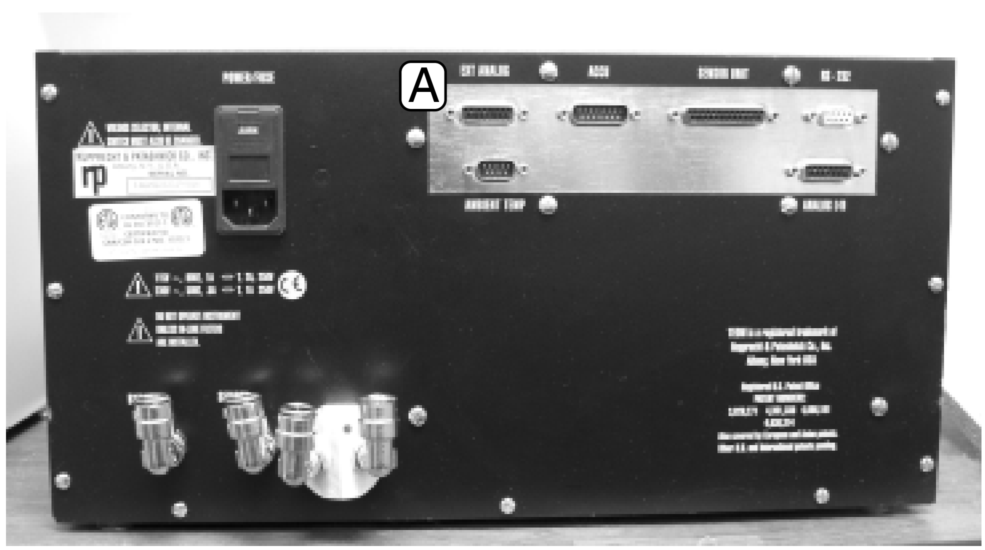


Figure 2-101. Back view of the control unit with the "EXT ANALOG" connection port (A) highlighted.

7) **Locate one of the power cords (Section 2.2).**
8) **Install the power cord into the power cord socket on the back of the 8500 module (Figure 2-100).**
9) **You must now set up the sensor unit (Section 2.4.6).**

2.4.6. Sensor Unit

The TEOM Series 1400a sensor unit is located below the 8500 module. The 8500 module is connected to an air inlet tube at the top of the sensor unit.

2.4.6.1. Sensor Unit Connections

Follow these steps to assemble the sensor unit connections:

1) **Cut a 4 cm (1 1/2-inch) diameter hole in the roof of your monitoring site.**
2) **Locate the sensor unit (Figure 2-102).**

Figure 2-102. TEOM Series 1400a sensor unit.

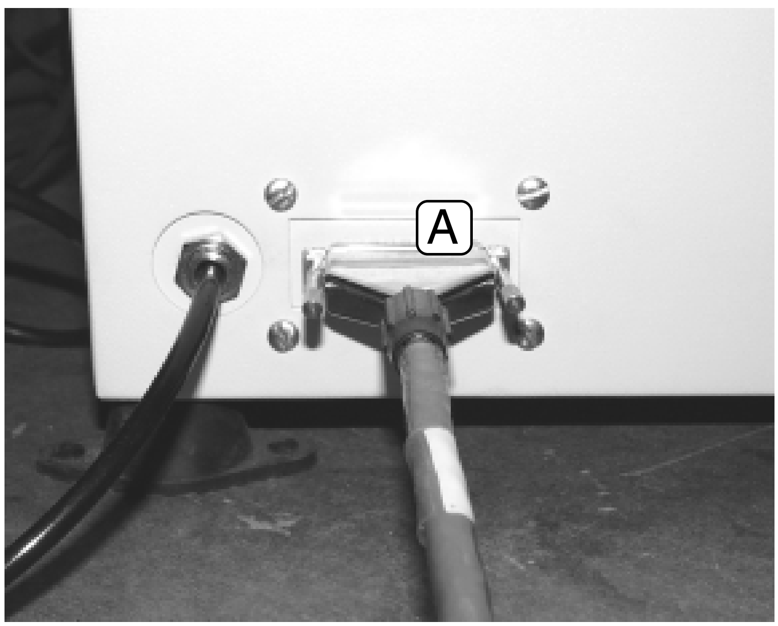
3) Install the sensor unit on a sturdy surface directly below the 4 cm (1 1/2-inch) diameter port in the roof.

4) Locate the electric- and air-connecting cable that is connected to the control unit (Section 2.4.3.1).

5) Install the electric connector of the electric- and air-connecting cable into the 25-pin connection port on the sensor unit (Figure 2-103).

NOTE: Ensure that the electric- and air-connecting cable is not bent sharply or kinked.

Figure 2-103. Electric- and air-connecting cable installed on the sensor unit with the electrical connector (A) highlighted.



6) Install the black tubing of the electric- and air-connecting cable into the air flow port on the sensor unit (Figure 2-104).

NOTE: Ensure that the electric- and air-connecting cable is not bent sharply or kinked.

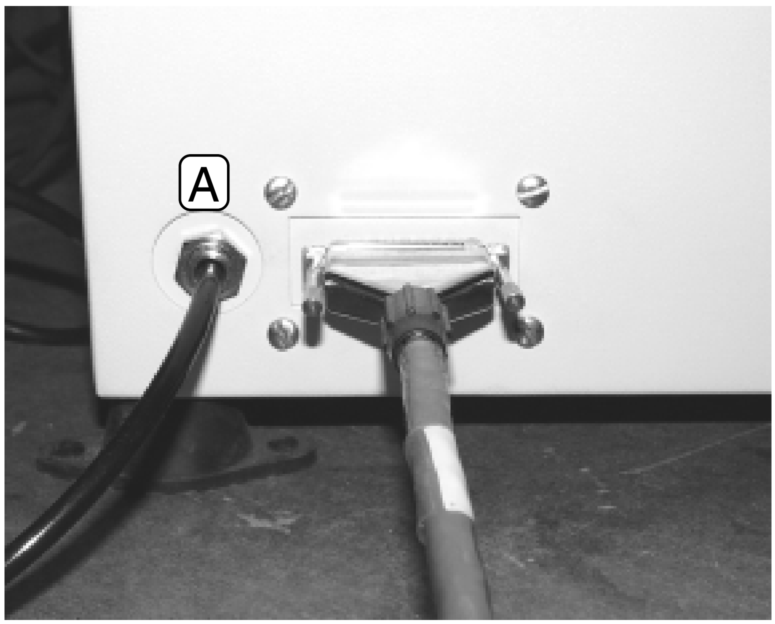


Figure 2-104. Electric- and air-connecting cable installed on the sensor unit with the air flow port (A) highlighted.

7) You must now assemble the flow splitter (Section 2.5.1).

2.5. Installing the Sampling System

To install the sampling system, you must set up the flow splitter assembly (Section 2.5.1), tripod assembly (Section 2.5.2), sample tube assembly (Section 2.5.3) and the sampling system assembly (Section 2.5.4), and then choose an appropriate inlet (Section 2.5.5).

2.5.1. Flow Splitter Assembly

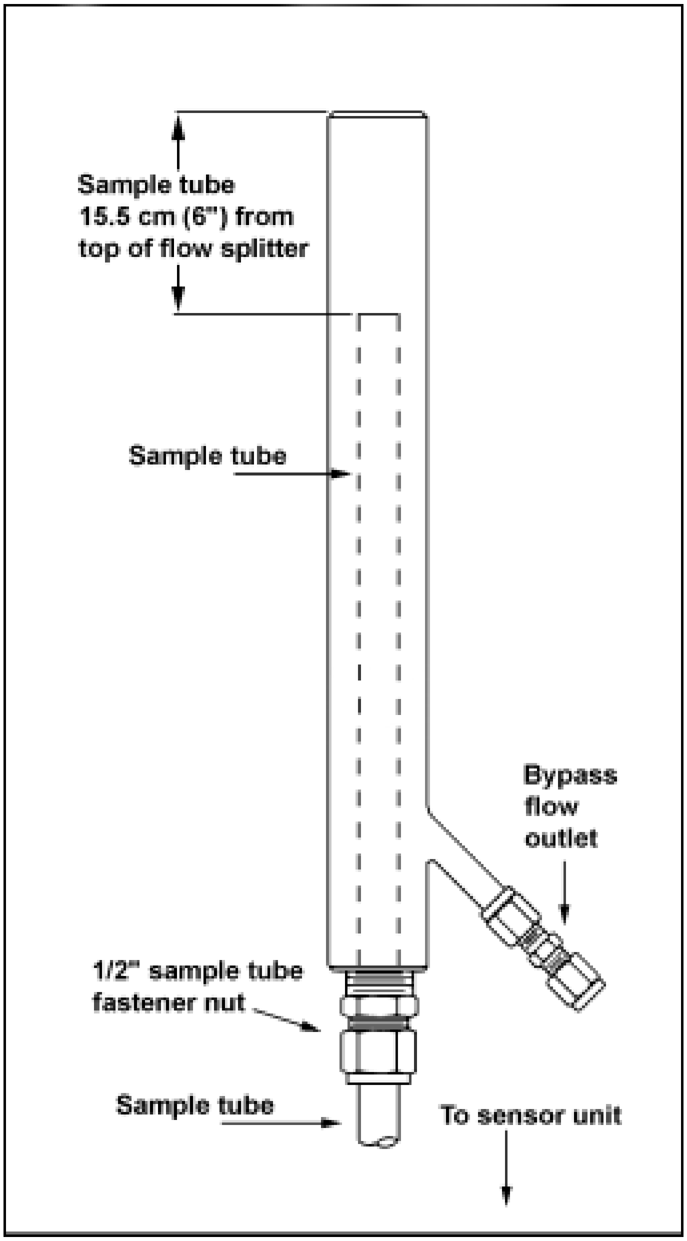
An isokinetic flow splitter (Figures 2-105 and 2-106) is used in combination with a second automatic flow controller to divide the sample flow into two components after the air stream passes through the size-selective inlet. The two sample flow components are the main flow (3 l/min) that flows to the mass transducer, and the auxiliary (or bypass) flow (13.67 l/min) that is maintained by the second flow controller. The flow splitter should be located directly below the sample inlet (Figure 2-50).

Figure 2-105. Flow splitter.

Follow these steps to set up the flow splitter assembly:

1) Locate the flow splitter (Figures 2-105 and 2-106).

Figure 2-106. Drawing of a flow splitter.

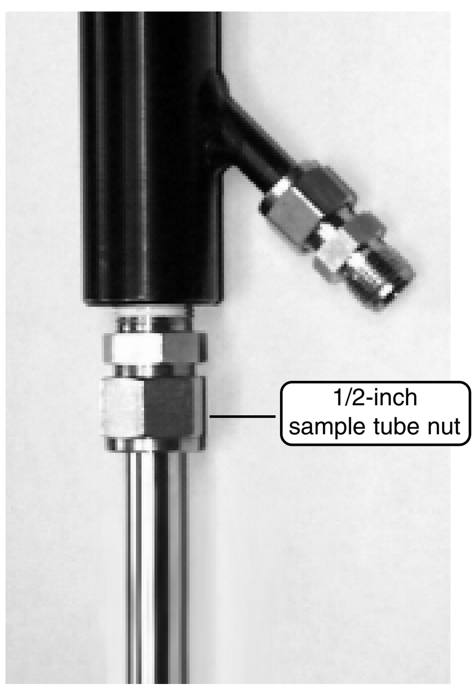


2) Ensure that the top of the sample tube (inside the flow splitter) (Figure 2-107) is 15.5 cm (6 inches) from the top of the flow splitter (Figure 2-106). If the top of the sample tube is 15.5 cm (6 inches) from the top of the flow splitter, go to step 6. If the top of the sample tube is not 15.5 cm (6 inches) from the top of the flow splitter, go to step 3.

Figure 2-107. Sample tube positioned above the top of the flow splitter.

3) **Loosen the 1/2-inch sample tube nut at the base of the flow splitter (Figure 2-108).**

Figure 2-108. Base of flow splitter with 1/2-inch sample tube nut highlighted.



4) Slide the sample tube that is located inside the flow splitter up or down until it is 15.5 cm (6 inches) from the top of the flow splitter (Figure 2-109).

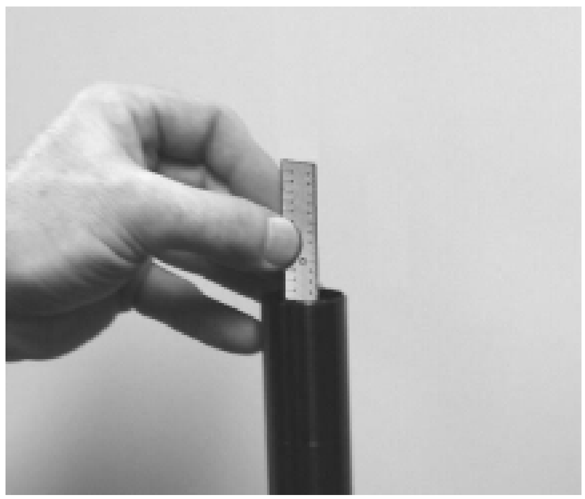


Figure 2-109. Measuring the distance from the top of the sample tube to the top of the flow splitter.

5) Tighten the 1/2-inch sample tube nut at the base of the flow splitter (Figure 2-110).

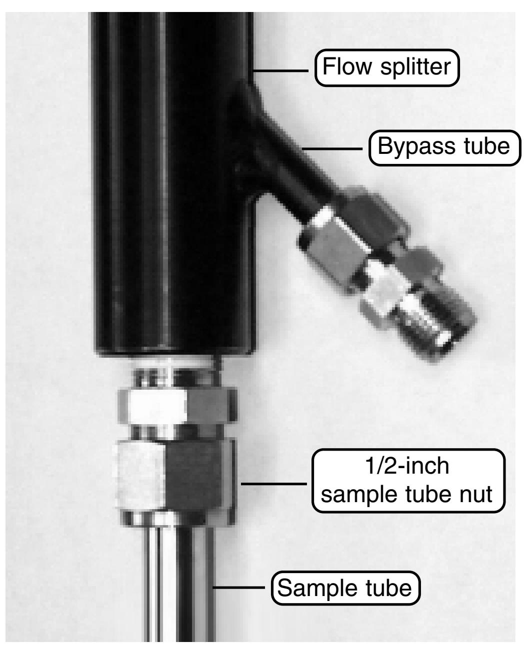


Figure 2-110. Close-up view of the bottom of the flow splitter.

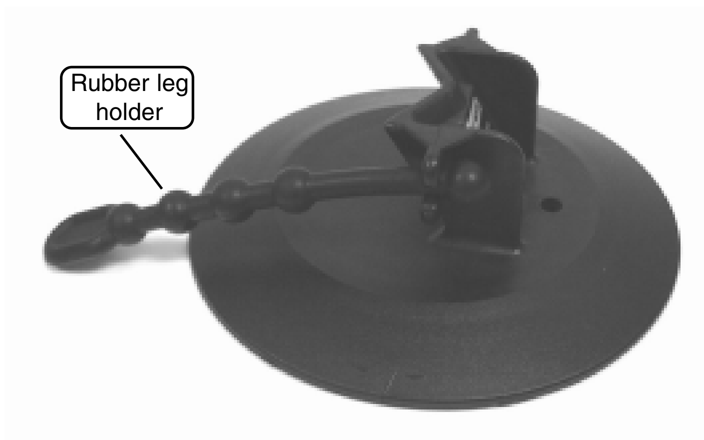
6) You must now assemble the tripod (Section 2.5.2).

2.5.2. Tripod Assembly

Follow these steps to install the tripod assembly:

1) Locate a tripod foot (Figure 2-111).

Figure 2-111. Tripod foot with rubber leg holder highlighted.



2) Pull off the rubber leg holder, if one is attached (Figure 2-112).

Figure 2-112. Removing the rubber leg holder.

3) Place one leg of the tripod onto the tripod foot.

4) Place a metal bracket over the rubber base of the tripod leg and into the 2 slots on the tripod foot (Figure 2-113).

Figure 2-113. Placing the metal bracket on the tripod foot.

5) Ensure that the bracket is placed over the rubber base on the end of the tripod leg (Figure 2-114).

Figure 2-114. Proper placement of the metal bracket.

6) Insert a plain washer and then a lock washer onto each threaded end of the bracket (Figure 2-115).

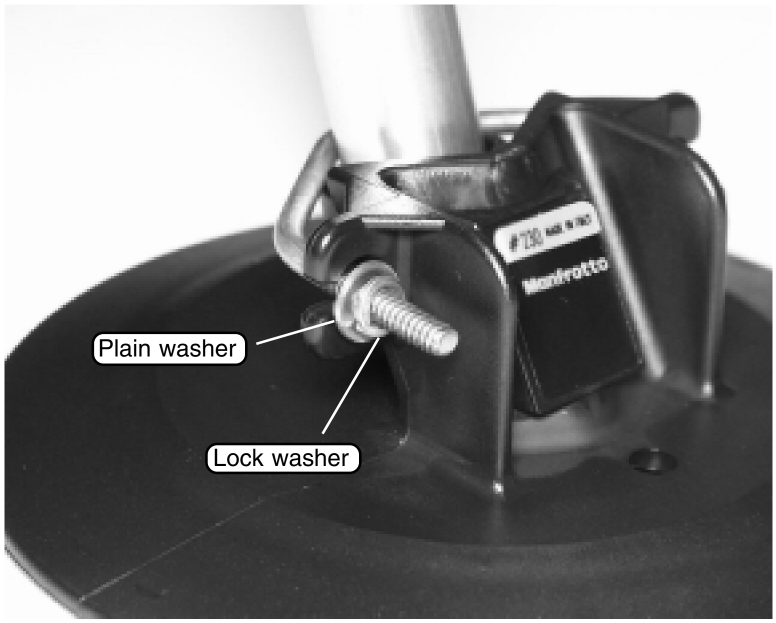


Figure 2-115. Washers placed on the metal bracket.

7) Install the nuts on the threaded ends of the bracket and tighten them with a 3/8-inch wrench (Figure 2-116).

NOTE: Hand-tighten both nuts on the bracket before tightening them with the wrench to ensure that the bracket is positioned properly on the tripod leg and tripod foot.

Figure 2-116. Tightening the metal bracket onto the tripod foot.

8) Repeat steps 1 through 7 for each leg of the tripod.

9) Slide the flow splitter up through the center hole of the tripod (Figures 2-117 and 2-118).

Figure 2-117. Center hole of the tripod with the holding ring (A) and the tightening knob (B) highlighted.

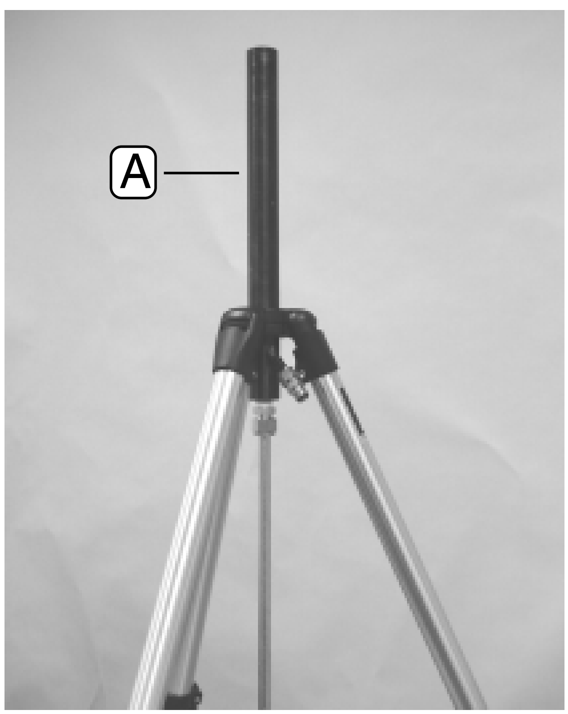


Figure 2-118. Tripod with an installed flow splitter (A) highlighted.

10) Tighten the tripod's holding ring onto the flow splitter with the tightening knob (Figure 2-117).

11) Adjust the legs of the tripod (Figure 2-119) to position the open end of the flow splitter at a height of 1.5 m to 1.8 m above the roof.


Figure 2-119. Adjusting the legs on the optional support tripod.

12) Center the tripod over the roof opening.

13) Fasten the tripod feet to the roof with wood screws (Figure 2-120). The length and type of screws required to fasten the tripod feet to the roof depends upon the type of roof surface. The tripod feet also may be attached to a pallet or 3/4-inch marine plywood, with the pallet or plywood secured by concrete blocks or sand bags.


Figure 2-120. Securing the tripod foot onto the roof surface.

14) You must now install the sample tube onto the 8500 module (Section 2.5.3).

2.5.3. Sample Tube Assembly

Follow these steps to install the sample tube onto the 8500 module:

1) Locate a sample tube extension (Section 2.2).

NOTE: Two 1-meter sample tube extensions are provided with the unit, but additional lengths can be purchased from R&P, if needed.

2) Locate the quick-connect fitting on the bottom of the sample tube of the flow splitter (Figure 2-121).

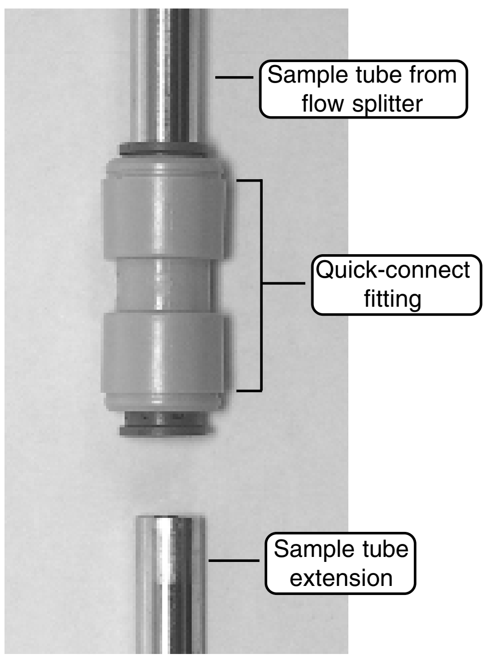


Figure 2-121 (left). Sample tube from flow splitter with the quick-connect fitting and sample tube extension highlighted.

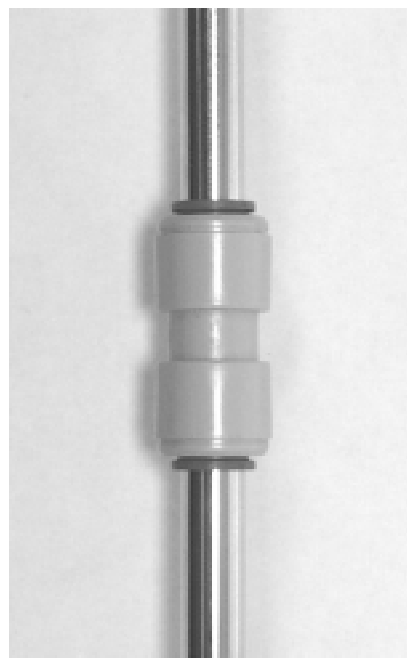


Figure 2-122 (right). Sample tube from flow splitter with sample tube extension inserted into the quick-connect fitting.

3) Insert the sample tube extension into the quick-connect fitting on the bottom sample tube of the flow splitter (Figure 2-122). Use enough sample tube extensions to reach from the flow splitter to the main inlet (Figure 2-123) located on top of the 8500 module. Use the shortest possible length of sample tube extension for best results. You may cut the sample tube extension as necessary; however, you must ensure that the cut ends of the sample tube extension are beveled and free of any sharp edges or burrs.

Figure 2-123. Top of 8500 module.

4) Locate the 1/2-inch x 1/2-inch push-to-connect union fitting (Section 2.2).
5) Install one end of the union fitting onto the bottom of the sample tube extension.
6) Install the other end of the union fitting onto the main inlet located on the top of the 8500 module (Figure 2-123).
7) You must now set up the sampling system (Section 2.5.4).

2.5.4. Sampling System Setup

Follow these steps to install the sampling system components onto the flow splitter:

1) Place the ambient temperature sensor (Figure 2-124) on the roof of your monitoring site near the 4 cm diameter hole.

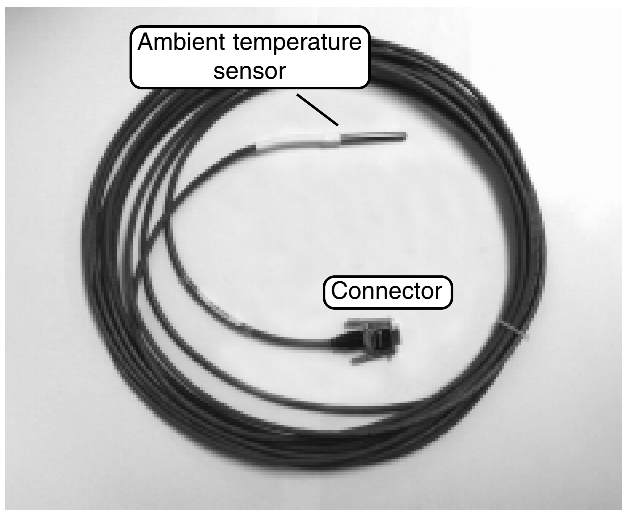


Figure 2-124. Ambient temperature sensor cable with ambient temperature sensor and connector highlighted.

2) Run the temperature sensor's cable through the 4 cm diameter hole and attach the cable's connector to the "AMBIENT TEMP" connection port on the back of the control unit (Figure 2-125).

IMPORTANT: Be sure to connect the ambient temperature sensor's cable to the connector on the back of the control unit.

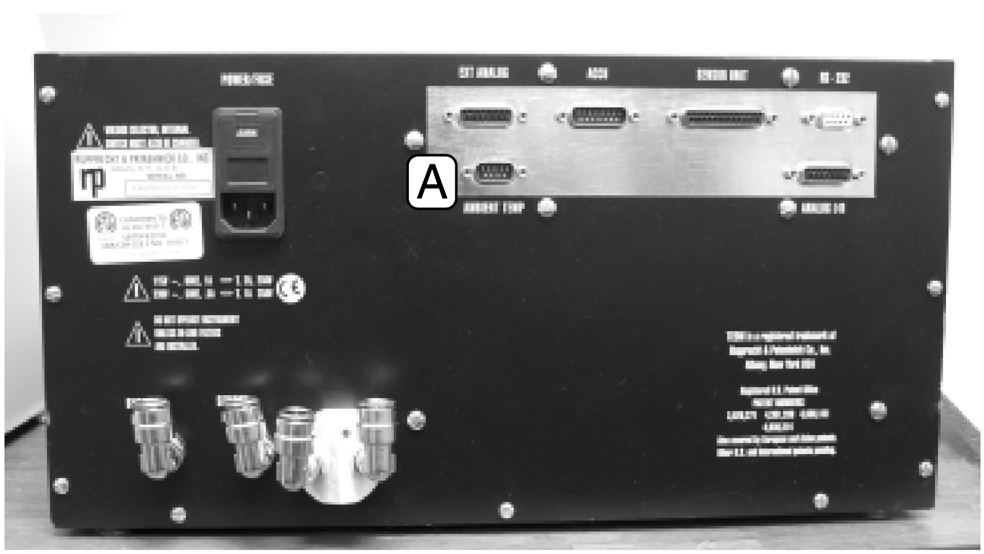


Figure 2-125. Back panel of control unit with the "AMBIENT TEMP" connection port (A) highlighted.

3) **Locate the 3/8-inch nylon green tubing (Section 2.2).**

4) **Cut a length of the 3/8-inch nylon green tubing that will reach between the bypass extension (Figure 2-126) of the flow splitter and the control unit. Ensure that the cut in the tubing is clean and perpendicular.**

5) **Insert one end of the cut 3/8-inch nylon green tubing into the open end of the bypass flow filter (Figures 2-126 and 2-127) located on the back of the control unit.**

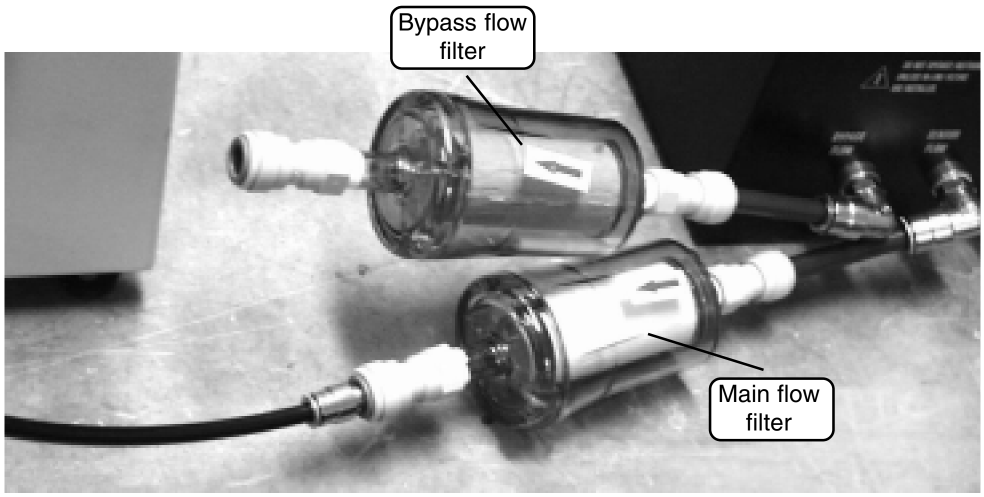


Figure 2-126. Bypass and main flow large in-line filters located on the back of the control unit.

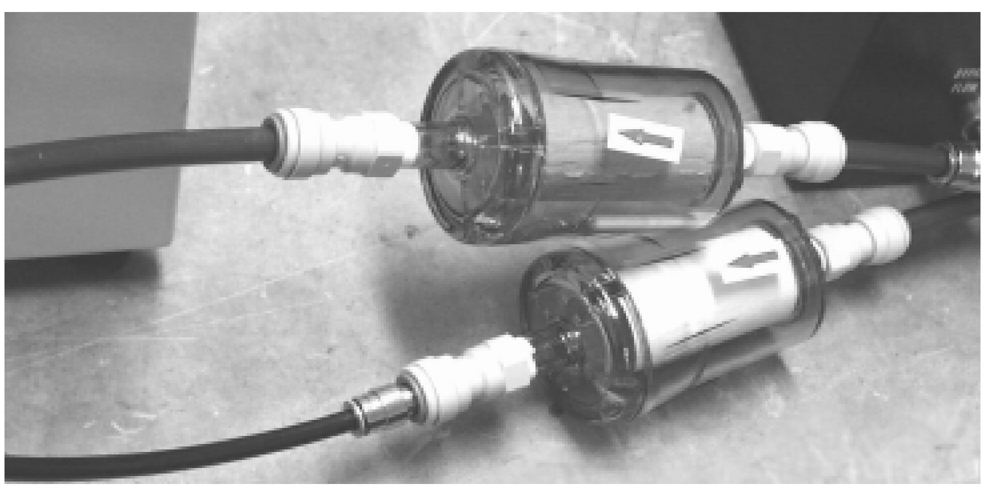


Figure 2-127. 3/8-inch green nylon tubing inserted into the bypass flow large in-line filter.

6) Remove the fastening nut from the bypass extension (Figure 2-128) of the flow splitter.

Figure 2-128. Removing the fastening nut from the bypass extension.

7) Remove the rubber ring from the bypass extension fastening nut (Figure 2-129).

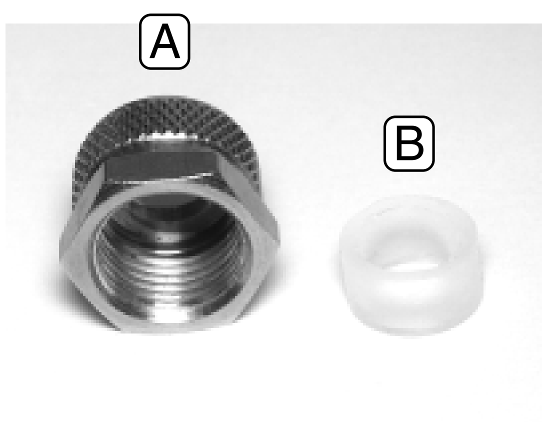
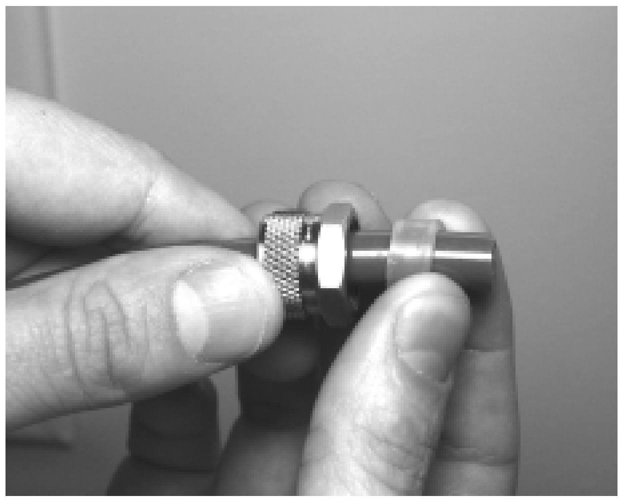


Figure 2-129. Bypass extension fastening nut (A) and rubber ring (B).

8) Install the bypass extension fastening nut onto the open end of the green bypass tubing (Figure 2-130). Ensure that the knurled or bumpy side of the bypass extension fastening nut is directed down the green bypass tubing, toward the control unit.

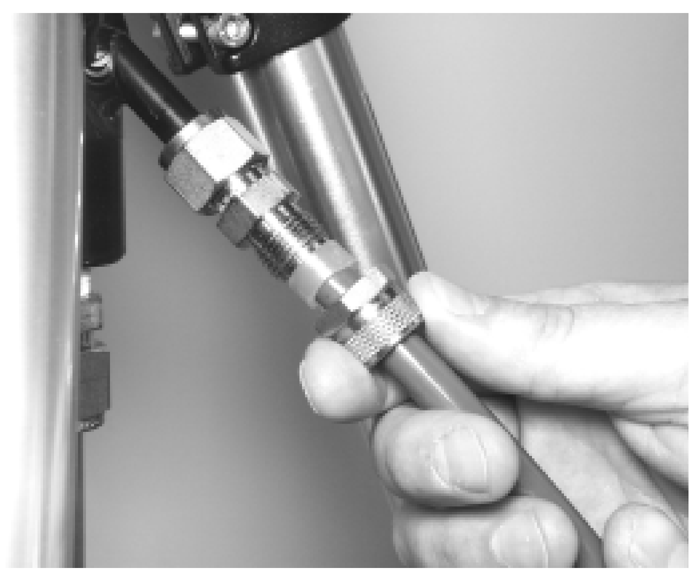
Figure 2-130. Installing the bypass extension and rubber ring onto the green bypass tubing.



9) Install the rubber ring onto the end of the green bypass tubing (Figure 2-130). Ensure that the rubber ring is approximately 1/4-inch from the end of the green bypass tubing.

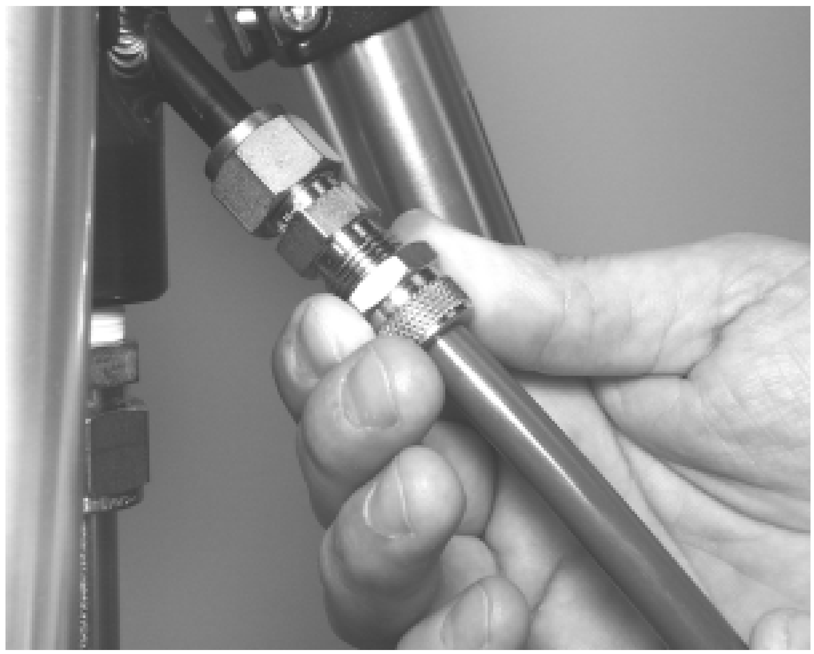
10) Insert the green bypass tubing into the bypass extension (Figure 2-131).

Figure 2-131. Installing the green bypass tubing onto the bypass extension.



11) Tighten the bypass extension fastening nut onto the bypass extension (Figure 2-132).

Figure 2-132. Tightening the fastening nut onto the bypass extension.



12) Starting at the bypass extension (Figure 2-132) of the flow splitter, measure 1-foot of the 3/8-inch nylon green tubing. Mark your measurement.

13) Cut the 3/8-inch nylon green tubing at the 1-foot mark. Ensure that the cut in the tubing is clean and perpendicular.

14) Locate the flow audit filter (Figure 2-133).

Figure 2-133. Flow audit filter with push-to-connect fitting (A), Swagelok fitting (B) and filter bowl (C) highlighted.

15) Locate the end of the tubing that is attached to the bypass extension, and install it into the push-to-connect fitting on the flow audit filter (Figures 2-133 and 2-134).

Figure 2-134. 3/8-inch nylon tubing inserted into the left-hand side of the flow audit filter.

16) Locate the end of tubing that is attached to the bypass flow filter on the back of the control unit, and install it into the Swagelok fitting on the flow audit filter (Figures 2-133 and 2-135). Be sure to turn the Swagelok fitting 1-1/4 turn past finger-tight with a wrench.

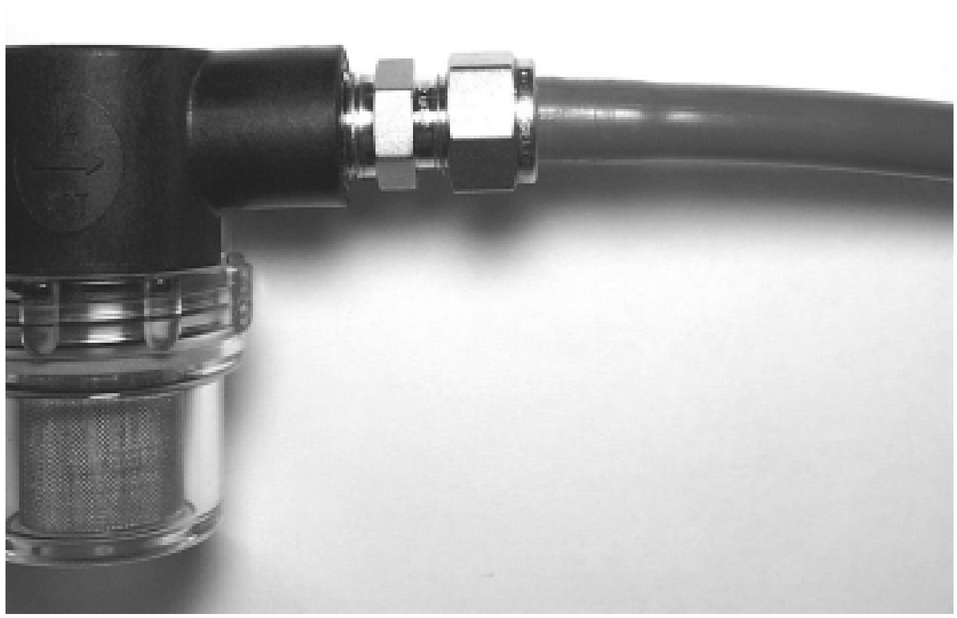


Figure 2-135. 3/8-inch nylon tubing inserted into the right-hand side of the flow audit filter.

17) After installing the flow audit filter into the bypass line, ensure that the filter bowl (Figure 2-133) is positioned downward to catch particulate matter.

18) Locate the ambient temperature sensor mount (Figure 2-136).

Figure 2-136. Ambient temperature sensor mount.

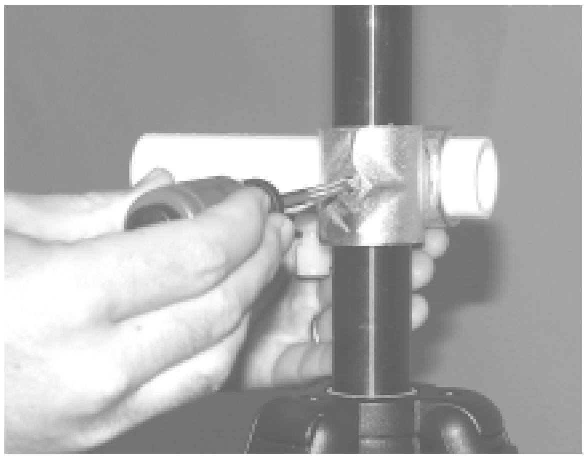
19) Slide the ambient temperature sensor mount over the top of the flow splitter (Figure 2-137), or mount it to another suitable outdoor location.

Figure 2-137. Ambient temperature sensor mount being installed onto the flow splitter.

20) Tighten the screw on the side of the ambient temperature sensor mount (Figure 2-138) with a flat-head screwdriver.

IMPORTANT: To avoid damaging the flow splitter, do not overtighten the ambient temperature sensor mount.

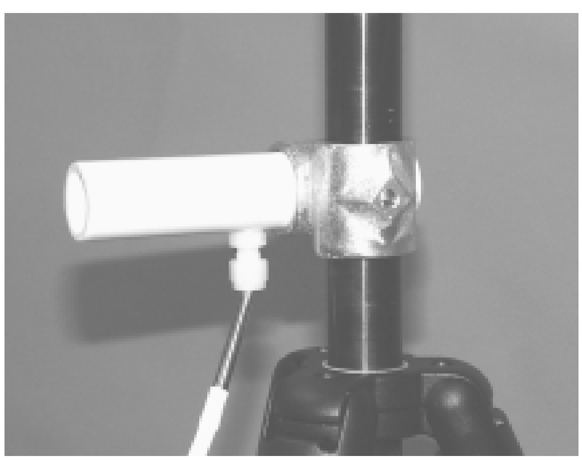
Figure 2-138. Securing the ambient temperature sensor mount to the flow splitter.



21) Insert the ambient temperature sensor into the ambient temperature sensor mount (Figure 2-139).

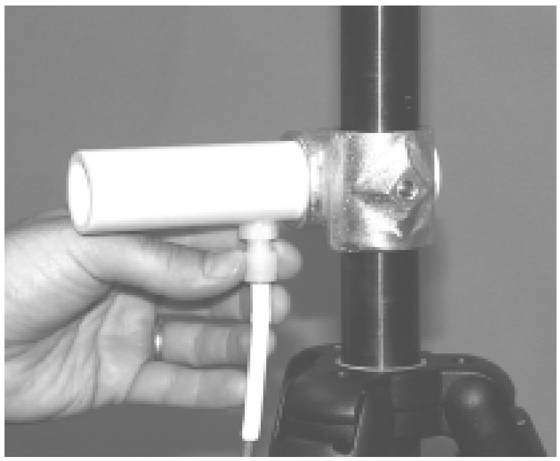
IMPORTANT: Be sure to install the ambient temperature sensor when installing the FDMS Series 8500 Monitor.

Figure 2-139. Installing the ambient temperature sensor into the ambient temperature sensor mount.



22) Tighten the ambient temperature sensor holding nut to secure the ambient temperature sensor (Figure 2-140) inside the mount.

Figure 2-140. Tightening the ambient temperature sensor holding nut.



23) Weather seal the opening in the roof.

2.5.5. Installing the Water Condensation Trap Kit

The water condensation trap kit helps prevent moisture from reaching the instrument when the 8500 FDMS system is installed in an air conditioned trailer or enclosure in high humidity conditions.

Follow these steps to install the water condensation trap kit:

1) Select a spot on the enclosure side wall that is lower than the instrument's control unit, and install the coalescing filter mounting bracket into the wall using the self-tapping screws and washers provided with the kit (Figure 2-141).

IMPORTANT: Ensure that the mounting bracket is positioned lower than the instrument's control unit.

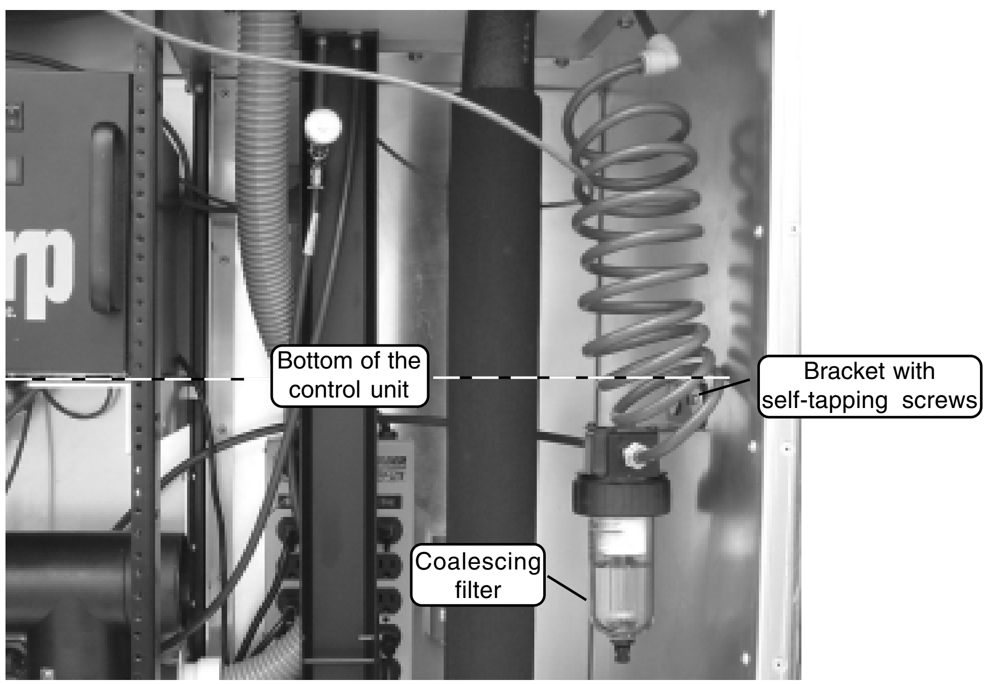


Figure 2-141. Coalescing filter bracket and filter installed on the enclosure wall lower than the control unit.

2) Cut the bypass tubing near where it enters the enclosure. Install the end of the tubing coil that has the 3/8-inch Camozzi elbow fitting into the bypass flow tube coming down from the flow splitter (Figure 2-142).

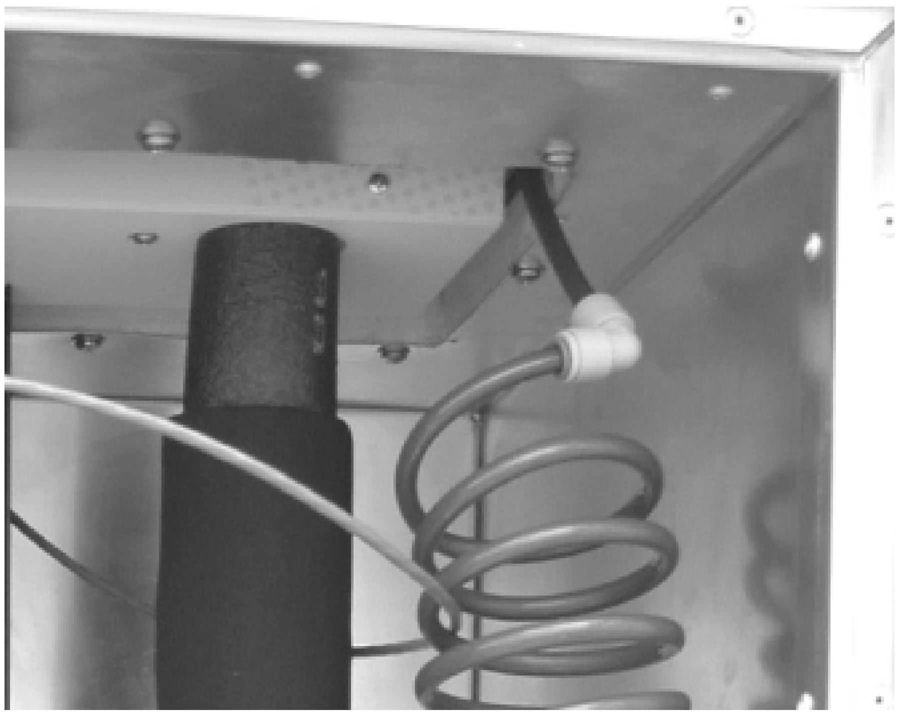


Figure 2-142. Tubing coil and elbow fitting connected to the bypass tubing where it enters the enclosure.

3) Install the other end of the cut bypass tubing (still connected to the bypass flow in-line filter located at the back of the instrument's control unit) into the push-to-connect fitting on the other side of the water trap filter.

4) Cut the tubing connected to the PURGE OUTLET fitting of the FDMS unit (Figures 2-93, 2-143) approximately eight inches below the bottom of the FDMS unit.

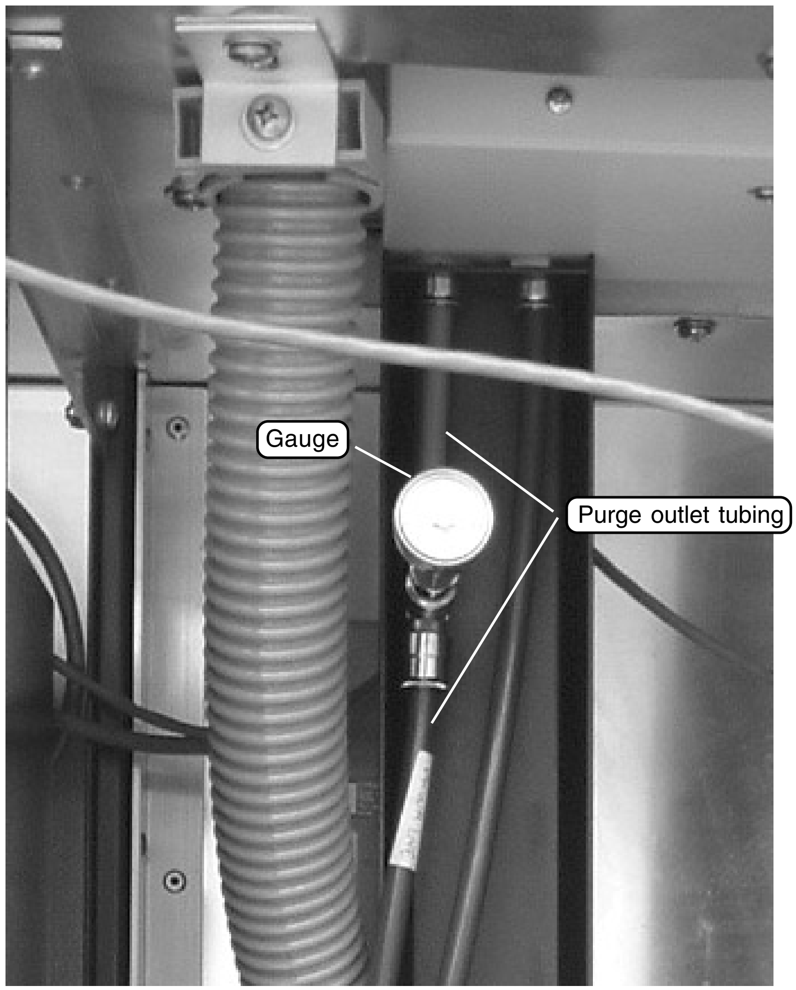


Figure 2-143. Gauge connected in-line in the purge outlet tubing.

5) Install the vacuum gauge in-line in the cut tubing by using the push-to-connect fittings on the top and bottom of the gauge (Figure 2-143).

6) Ensure that the enclosure temperature is set at or above 70F (20C) (Appendix K).

7) Empty water from the coalescing filter as needed. Either unscrew the bowl from the filter assembly and dispose of the water outside the enclosure, or set a waste container below the filter bowl inside the enclosure and loosen the drain screw at the bottom of the bowl, allowing the water to empty into the container.

IMPORTANT: Monitor and log the vacuum gauge reading. A pump in good condition should produce a vacuum that is at least 65 percent of ambient pressure. For example, if the ambient pressure is 29.92" Hg, the vacuum gauge should read at least 21" Hg. If the pump can not maintain a vacuum of 65 percent of ambient pressure, the pump may need to be rebuilt or replaced. Refer to Appendix E for rebuild kit or replacement pump part numbers.

NOTE: In extremely humid conditions, consider raising the enclosure temperature to 75F (24C) to avoid excess water accumulation in the trap (Appendix K).

2.5.6. Inlet Selection

The Series 8500 FDMS Monitor can be configured with a variety of inlet systems. This section describes the procedures for installing a sample inlet onto the sampling system setup (Section 2.5.6.1), and converting the Series 8500 FDMS Monitor from a PM-10 to a PM-1 monitor (Section 2.5.6.2), or to a PM-2.5 monitor (Section 2.5.6.3).

> NOTE: If your Series 8500 FDMS Monitor is configured for use as a PM-10 or PM-2.5 monitor with the original PM-10 inlet (Figure 2-144) and you are experiencing difficulties with rain intrusion, you can purchase the modified PM-10 inlet (Figure 2-145) from Thermo (57-004742). This inlet substantially reduces the possibility of rain intrusion, and is installed in the same manner as the PM-10 inlet. Also, you can convert the original PM-10 inlet to a modified PM-10 inlet by using the PM-10 Inlet Conversion Kit (55-004747). Conversion instructions are included with the kit.

2.5.6.1. Installing a Sample Inlet

Follow these steps to install a sample inlet onto the sampling system setup:

1) **Choose an appropriate sample inlet for your sampling needs (Figures 2-144, 2-145, 2-146, and 2-147).**

Figure 2-144 (left). Original PM-10 inlet: 16.7 l/min.

Figure 2-145 (right). Modified PM-10 inlet: 16.7 l/min.

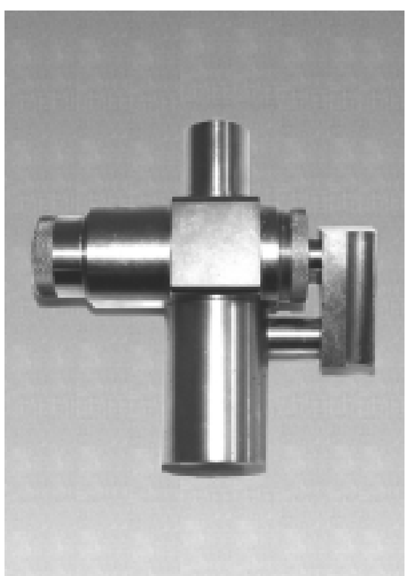


Figure 2-146 (left). Sharp cut cyclone (SCC) PM-2.5 second stage inlet: 16.7 l/min.

Figure 2-147 (right). Sharp cut cyclone (SCC) PM-1 second stage inlet: 16.7 l/min.

2) Slide the sample inlet onto the top of the flow splitter until it stops (Figure 2-148). Ensure that the entrance to the sample inlet (Figure 2-149) is 1.8 to 2.1 m above the roof.

Figure 2-148. Flow splitter with an installed modified PM-10 air inlet (A) highlighted.

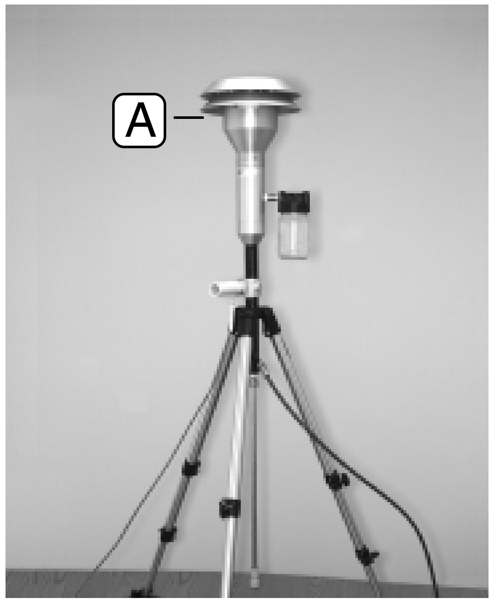
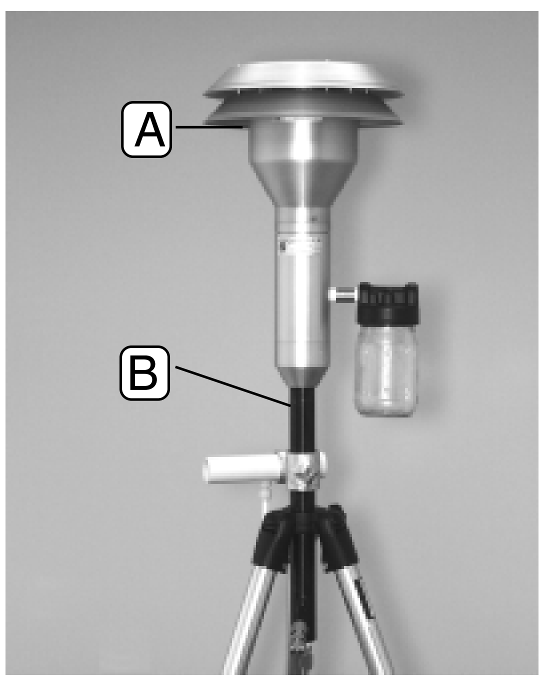


Figure 2-149. Modified PM-10 sample inlet installed onto a flow splitter (B) with the entrance to the sample inlet (A) highlighted.



3) Perform a leak check on the system (Section 3.5).

2.5.6.2. Converting from a PM-10 to a PM-1 Monitor

Follow these steps to convert the PM-10 Monitor to a PM-2.5 Monitor using the sharp cut cyclone (SCC) PM-1 second stage inlet:

1) **Remove the PM-10 inlet from the top of the flow splitter by pulling it straight upward (Figure 2-150).**

Figure 2-150. Removing the PM-10 inlet from the flow splitter.

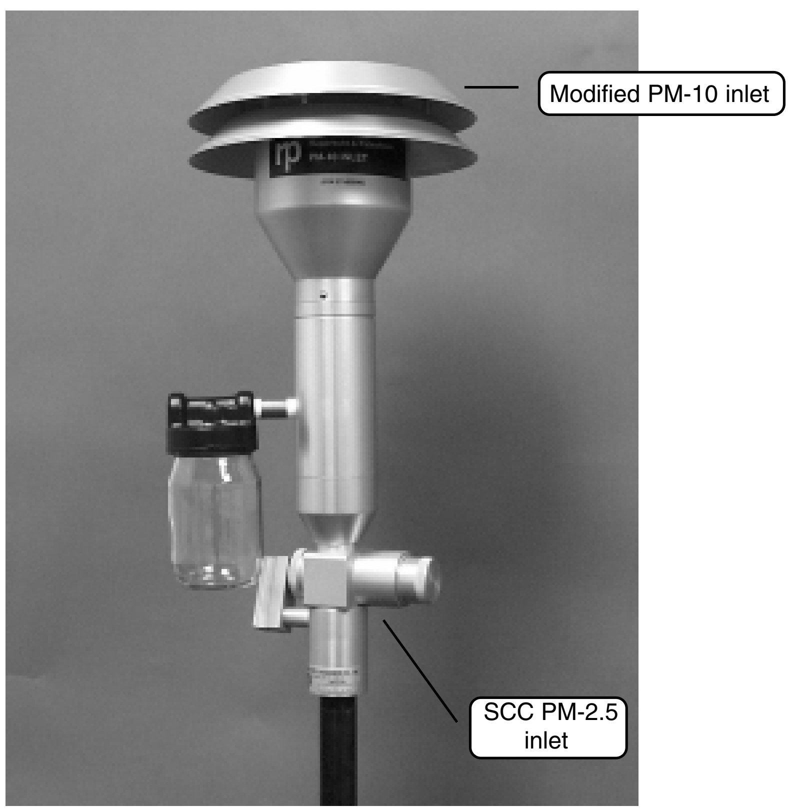
2) **Apply a small amount of silicone grease to the two O-rings inside of the base of the SCC PM-1 inlet (Figure 2-147).**
3) **Install the SCC PM-1 inlet onto the top of the flow splitter by pushing it straight down until it hits a stop.**
4) **Apply a small amount of silicone grease to the two O-rings inside of the base of the PM-10 inlet (Figure 2-144 or 2-145).**
5) **Install the PM-10 inlet onto the top of the SCC PM-1 inlet by pushing it straight down until it hits a stop.**
6) **The FDMS Series 8500 Monitor is now configured as a PM-1 monitor. There is no difference in monitor programming or operation with the SCC PM-1 second stage inlet installed.**
7) **Perform a leak check on the system (Section 3.5).**

2.5.6.3. Converting from a PM-10 to a PM 2.5 Monitor

Follow these steps to convert the PM-10 Monitor to a PM-2.5 Monitor using the sharp cut cyclone (SCC) second stage inlet:

1) **Remove the PM-10 inlet from the top of the flow splitter by pulling it straight upward (Figure 2-150).**
2) **Apply a small amount of silicone grease to the 2 O-rings inside of the base of the SCC PM-2.5 inlet (Figure 2-146).**
3) **Install the SCC PM-2.5 inlet onto the top of the flow splitter by pushing it straight down until it hits a stop.**
4) **Apply a small amount of silicone grease to the two O-rings inside of the base of the PM-10 inlet (Figure 2-144 or 2-145).**
5) **Install the PM-10 inlet onto the top of the SCC PM-2.5 inlet by pushing it straight down until it hits a stop (Figure 2-151).**

Figure 2-151. Modified PM-10 inlet installed onto a sharp cut cyclone (SCC) PM-2.5 inlet.



6) The Series 8500 FDMS Monitor is now configured as a PM-2.5 monitor. There is no difference in monitor programming or operation with the SCC PM-2.5 second stage inlet installed.

7) Perform a leak check on the system (Section 3.5).

Section 3: Sample Preparation

This section explains how to install and replace TEOM filters and 47 mm filters, and discusses the length of the filters' lifetime. The Series 8500 FDMS module and sensor unit always must be operated with a TEOM filter installed in the mass transducer and a 47 mm filter installed in the 8500 module. Be sure to install both filters before applying power to the instrument. Also, this section explains how to turn on the monitor and perform a leak check.

3.1. TEOM Filter Replacement

✘ Do not handle TEOM filters with your fingers.

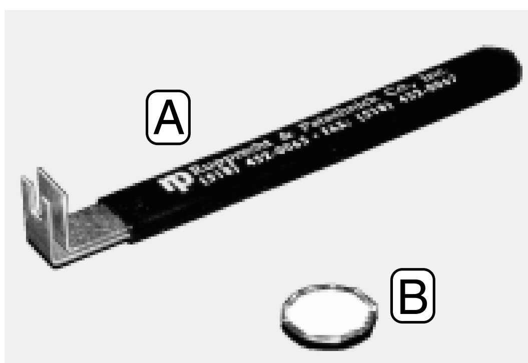
Do not handle new TEOM filters with your fingers. Use the filter exchange tool (Figure 3-1) provided with the instrument to replace filters.

3.1.1. First-Time TEOM Filter Installation

Follow these steps to install a TEOM filter before the first sampling run:

1) Ensure that the filter exchange tool (Figure 3-1) is clean and free of any contamination that might be transferred to the TEOM filter.

Figure 3-1. Close-up of the filter exchange tool (A) and a TEOM filter (B).



2) Open the door of the sensor unit (Figures 3-2 and 3-3).

Figure 3-2. TEOM sensor unit.

Figure 3-3. TEOM sensor unit with door open.

3) Locate the silver handle on the front of the mass transducer (Figure 3-4). Note that there is a shipping latch in the middle of this handle.

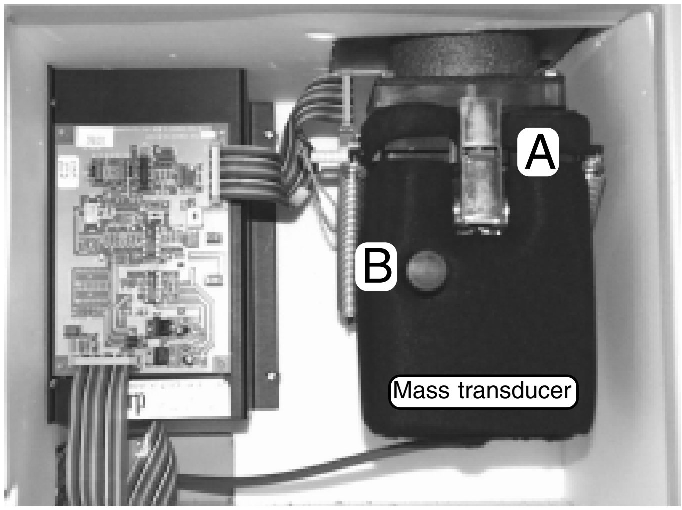


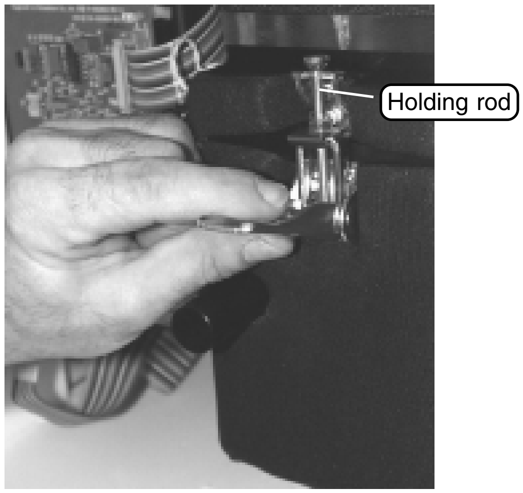
Figure 3-4. Mass transducer in the closed position with the silver handle (A) and black knob (B) highlighted.

4) Grasp the silver handle and move the shipping latch upward with your thumb (Figure 3-5).

Figure 3-5. Lifting the shipping latch on the silver handle.

5) Pull down on the silver handle (Figure 3-6).

Figure 3-6. Pulling the silver handle down.



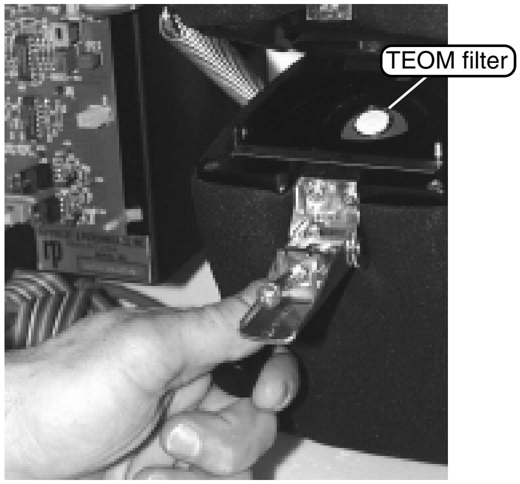
6) **Pull the holding rod off the latch plate (Figure 3-7).**

Figure 3-7. Releasing the holding rod on the mass transducer.

7) **With the mass transducer unlatched, grasp the black knob (Figure 3-4) and swing the bottom of the mass transducer downward, exposing the tapered element (TE) (Figure 3-8). An old TEOM filter may be already installed on the TE. Refer to Section 3.1.4 to remove this filter.**

NOTE: If the control unit is operating (power is applied to the control unit) when you open the mass transducer, the tapered element (TE) will automatically stop oscillating.

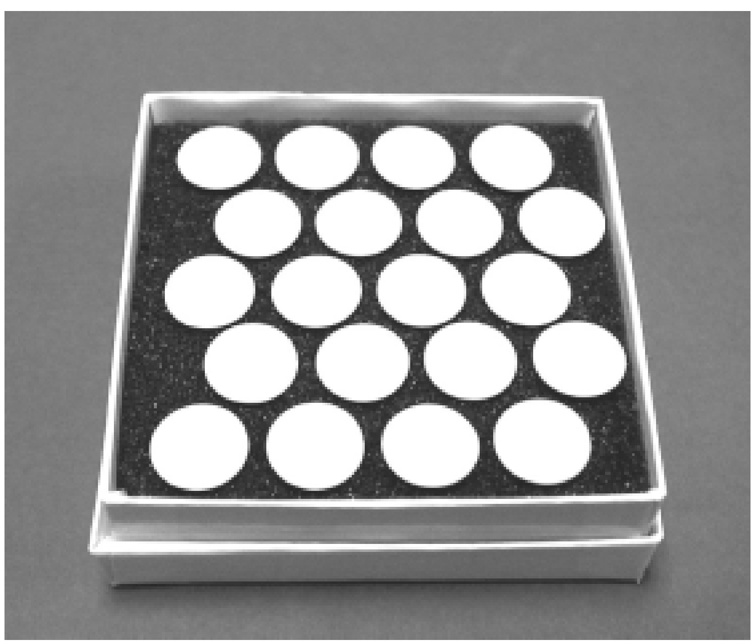
Figure 3-8. Opening the mass transducer.



✘ Do not handle TEOM filters with your fingers.

8) Pick up a new TEOM filter from the box of filters (Figure 3-9) with the filter exchange tool (Figure 3-1) so that the filter disk lies between the fork and the upper tab of the tool and the hub of the filter lies between the tines of the fork (Figures 3-10 and 3-11). Do not touch the filter with your fingers while picking it up with the filter exchange tool.

Figure 3-9. TEOM filters.



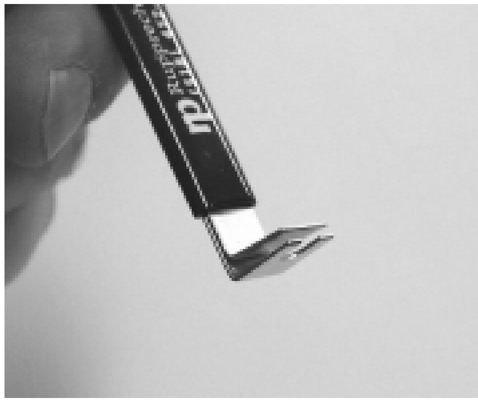


Figure 3-10 (left). Close-up of the filter exchange tool.

Figure 3-11 (right). Close-up of the filter exchange tool holding a TEOM filter.

9) Hold the filter exchange tool in line with the tapered element (Figures 3-12 and 3-13) and lightly place the hub of the filter onto the tip of the tapered element.

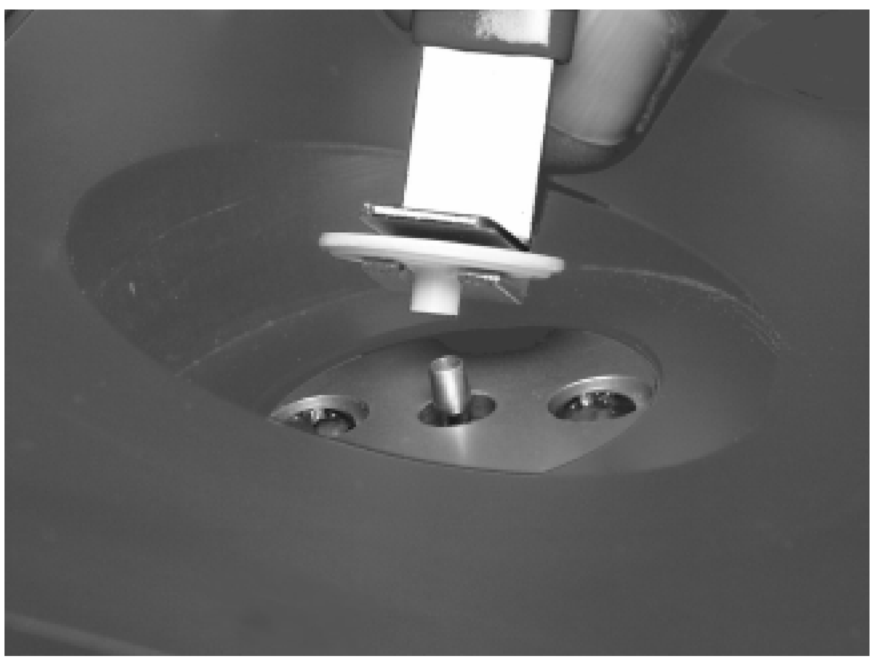


Figure 3-12. Holding the filter exchange tool in line with the tapered element.

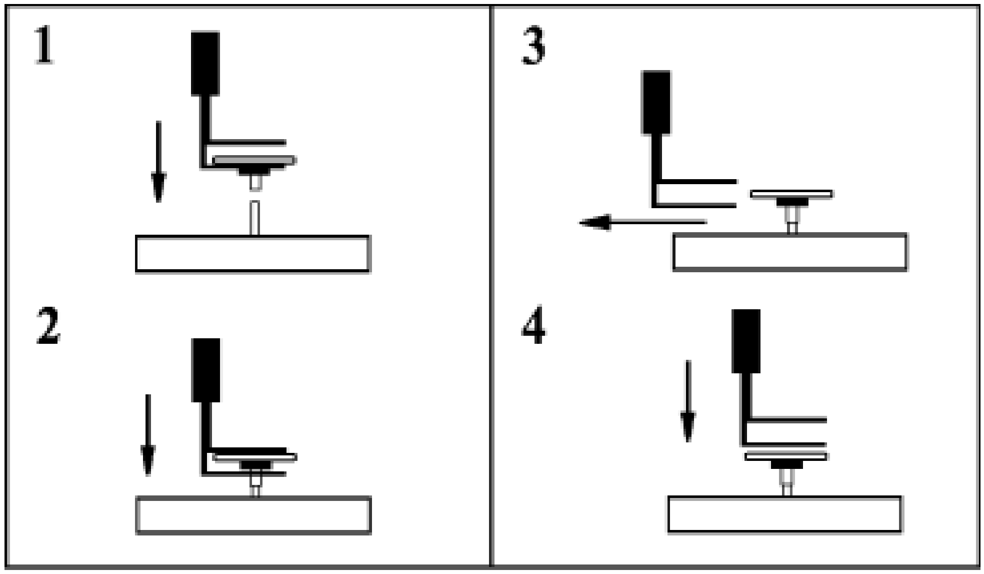


Figure 3-13. Filter installation.

10) Gently press down on the TEOM filter to ensure that it is seated properly (Figure 3-13).

11) Remove the filter exchange tool by slowly retracting it sideways until it clears the filter (Figure 3-13). Do not disturb the filter.

12) Place the bottom of the filter exchange tool on top of the filter (Figures 3-13) and apply downward pressure (approximately 0.5 kg or 1 lb) to seat the filter firmly in place.

13) Raise the mass transducer to the closed position using the black knob.

14) Fasten the holding rod onto the latch plate.

15) Push the silver handle up until the shipping latch snaps into place.

16) Close and latch the door to the sensor unit. Keep the door open for as short a time as possible to minimize the temperature change in the system.

17) Supply power to the instrument at the appropriate voltage (Section 2.3.1).

18) Press the “POWER” switch on the front panel of the control unit (Figure 3-14). The Title screen will appear on the control unit’s four-line display (Figure 3-15). After a moment, the Main screen (Figure 3-16) will display.

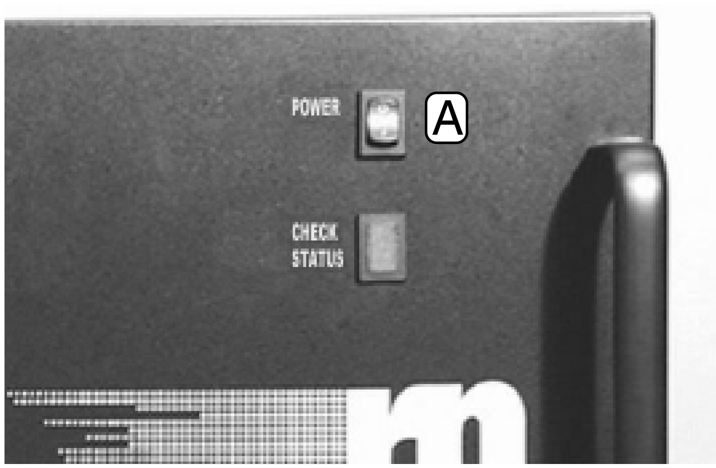


Figure 3-14. Control unit with the “POWER” button (A) highlighted.

Figure 3-15. Title screen.

```
      FDMS Series 8500

       Copyright 2004
  Rupprecht + Patashnick
```

Figure 3-16. Main screen.

```
OK     4+  21%  NU     09:39
Mass Conc              11.5
01-Hr MC               12.5
08-Hr MC                8.3
```

19) Plug the pump (Figure 3-17) into an appropriate power source to draw a sample stream through the system.

Figure 3-17. Sample pump.

20) Press the <DATA STOP> key on the control unit's keypad (Figure 3-18).

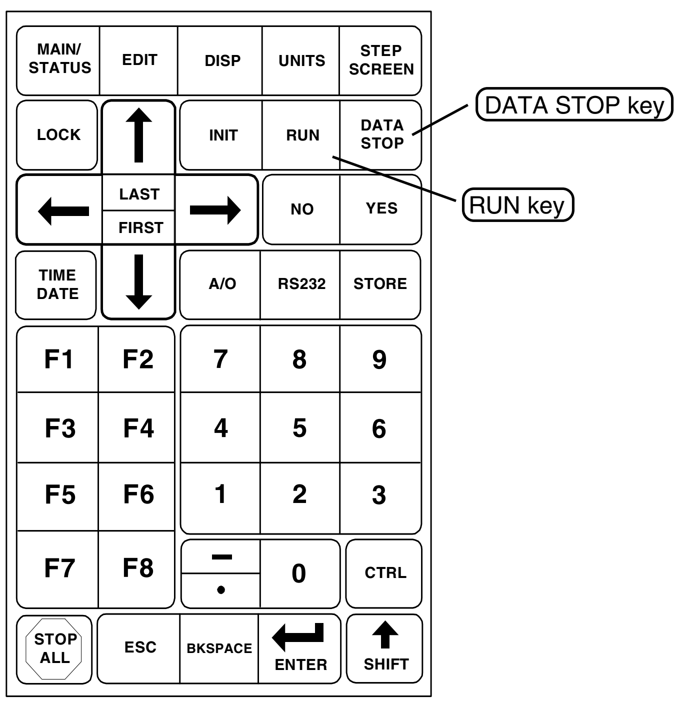


Figure 3-18. TEOM control unit keypad.

21) Reset the unit by pressing <F1> or <RUN> on the control unit's keypad.

22) Wait 5 minutes to allow the temperatures to stabilize inside the transducer and sensor unit.

23) Press the <DATA STOP> key on the control unit's keypad.

24) Open the door of the sensor unit.

25) Open the mass transducer.

26) Press straight down on the filter with the bottom of the filter exchange tool (Figure 3-13). This ensures that the filter is properly seated after it has experienced an increase in temperature.

27) Close the mass transducer and sensor unit door.

28) Reset the unit by pressing <F1> or <RUN> on the control unit's keypad.

29) Wait 5 minutes.

30) Look at the change in the TE's oscillating frequency on the Main screen of the control unit (Figure 3-19). The last two digits of the reading will fluctuate (due to noise) and the rest will remain steady. If more than the last two digits fluctuate in this reading, this indicates that the TEOM filter is loose. Repeat steps 23-30 to re-seat the filter.

Figure 3-19. Main screen with the TEOM tapered element (TE) oscillating frequency highlighted.

```
OK     4+    15%  NU   09:39
Aux Flow              13.66
Noise                 0.034
Frequency         187.05705
```

Oscillating frequency

3.1.2. Routine TEOM Filter Installation

Follow these steps to install a TEOM filter into the Series 1400a sensor unit:

1) **Ensure that the filter exchange tool (Figure 3-1) is clean and free of any contamination that might be transferred to the TEOM filter.**
2) **Press the “POWER” switch to turn on the control unit (Figure 3-14).**
3) **Press the <DATA STOP> key on the control unit’s keypad (Figure 3-18).**
4) **Open the door of the sensor unit (Figures 3-2 and 3-3).**
5) **Locate the silver handle on the front of the mass transducer (Figure 3-4). Note that there is a shipping latch in the middle of this handle.**
6) **Grasp the silver handle and move the shipping latch upward with your thumb (Figure 3-5).**
7) **Pull down on the silver handle (Figure 3-6).**
8) **Pull the holding rod off the latch plate (Figure 3-7).**

✓ Keep the door to the Series 1400a sensor unit open for as short a time as possible to minimize the temperature change in the system.

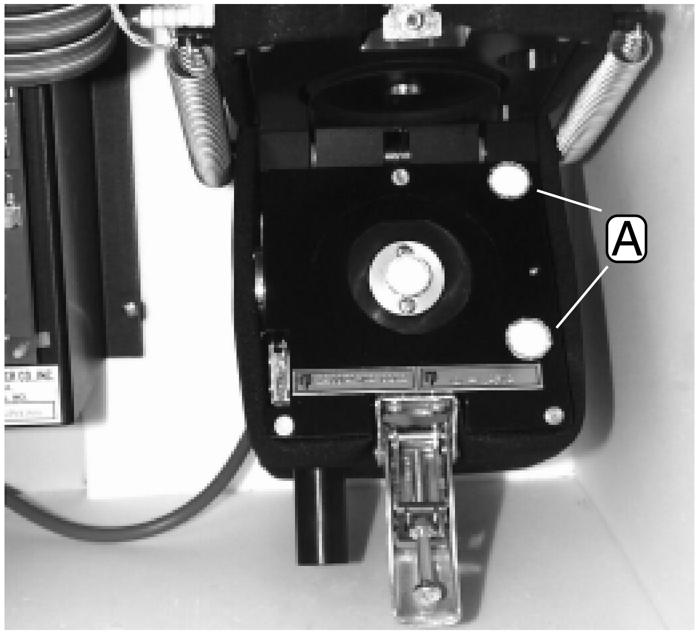
9) **With the mass transducer unlatched, grasp the black knob (Figure 3-4) and swing the bottom of the mass transducer downward, exposing the tapered element (TE) (Figure 3-8). An old TEOM filter may be already installed on the TE. Refer to Section 3.1.4 to remove this filter.**

   NOTE: If the control unit is operating (power is applied to the control unit) when you open the mass transducer, the tapered element (TE) will automatically stop oscillating.

✘ Do not handle TEOM filters with your fingers.

10) **Pick up a new, conditioned TEOM filter (Section 3.1.3) from one of the filter holders (Figure 3-20) with the filter exchange tool (Figure 3-1) so that the filter disk lies between the fork and the upper tab of the tool and the hub of the filter lies between the tines of the fork (Figures 3-10 and 3-11). Do not touch the filter with your fingers while picking it up with the filter exchange tool.**

Figure 3-20. Open mass transducer with extra filters in the filter holders (A) highlighted.



11) Hold the filter exchange tool in line with the tapered element (Figures 3-12 and 3-13) and lightly place the hub of the filter onto the tip of the tapered element.

12) Gently press down on the TEOM filter to ensure that it is seated properly (Figure 3-13).

13) Remove the filter exchange tool by slowly retracting it sideways until it clears the filter (Figure 3-13). Do not disturb the filter.

✔ Keep the door to the Series 1400a sensor unit open for as short a time as possible to minimize the temperature change in the system.

14) Place the bottom of the filter exchange tool on top of the TEOM filter (Figures 3-13) and apply downward pressure (approximately 0.5 kg or 1 lb) to seat the filter firmly in place.

15) Raise the mass transducer to the closed position using the black knob.

16) Fasten the holding rod onto the latch plate.

17) Push the silver handle up until the shipping latch snaps into place.

18) Close and latch the door to the sensor unit. Keep the door open for as short a time as possible to minimize the temperature change in the system.

19) **Reset the unit by pressing <F1> or <RUN> on the control unit's keypad.**

20) **Wait 5 minutes to allow the temperatures to stabilize inside the transducer and sensor unit.**

21) **Press the <DATA STOP> key on the control unit's keypad.**

22) **Open the door of the sensor unit.**

23) **Open the mass transducer.**

24) **Press straight down on the TEOM filter with the bottom of the filter exchange tool (Figure 3-13). This ensures that the filter is properly seated after it has experienced an increase in temperature.**

25) **Close the mass transducer and sensor unit door.**

26) **Reset the unit by pressing <F1> or <RUN> on the control unit's keypad.**

27) **Wait 5 minutes.**

28) **Look at the change in the TE's oscillating frequency on the Main screen of the control unit (Figure 3-19). The last two digits of the reading will fluctuate (due to noise) and the rest will remain steady. If more than the last two digits fluctuate in this reading, this indicates that the TEOM filter is loose. Repeat steps 21-28 to re-seat the filter.**

3.1.3. Filter Pre-Conditioning

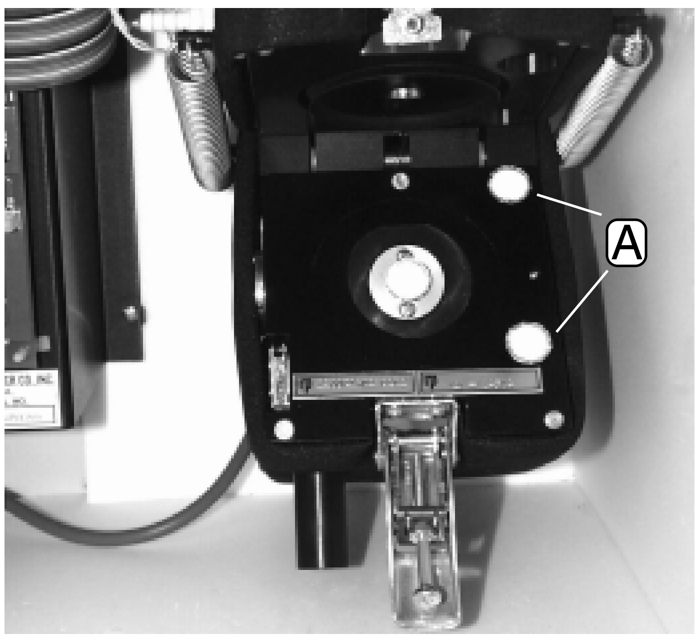
TEOM filters must be preconditioned to avoid excessive moisture buildup prior to their use in the system.

✓ Use the two holders on the right side of the mass transducer (inside) to store the next two TEOM filters to be used.

Follow these steps to precondition the TEOM filters:

1) Place two TEOM filters on the TEOM filter holders of the mass transducer (Figure 3-21) to condition the filters.

Figure 3-21. Open mass transducer with extra TEOM filters in the filter holders (A) highlighted.



✘ Do not handle TEOM filters with your fingers.

2) When it is time to install a new TEOM filter, use a conditioned filter from one of the filter holders.

3) Replace the conditioned TEOM filter that was on the filter holder with a new filter.

3.1.4. TEOM Filter Removal

Follow these steps to remove a TEOM filter from the Series 1400a sensor unit:

1) **Turn on the sample pump by plugging it into an appropriate power source (Figure 3-17).**
2) **Press the "POWER" switch to turn on the control unit (Figure 3-14).**
3) **Press the <DATA STOP> key on the control unit's keypad (Figure 3-18).**
4) **Open the door of the sensor unit (Figures 3-2 and 3-3).**

✔ Keep the door to the Series 1400a sensor unit open for as short a time as possible to minimize the temperature change in the system.

5) **Locate the silver handle on the front of the mass transducer (Figure 3-4). Note that there is a shipping latch in the middle of this handle.**
6) **Grasp the silver handle and move the shipping latch upward with your thumb (Figure 3-5).**
7) **Pull down on the silver handle (Figure 3-6).**
8) **Pull the holding rod off of the latch plate (Figure 3-7).**
9) **With the mass transducer unlatched, hold the black knob (Figure 3-4) and swing the bottom of the mass transducer downward, exposing the filter (Figure 3-8). When the mass transducer is in the open position, the tapered element (TE) will automatically stop oscillating.**

✘ Do not handle TEOM filters with your fingers.

10) **Carefully insert the lower fork of the filter exchange tool (Figures 3-22 and 3-23) under the TEOM filter so that the filter disk is between the fork and the upper tab of the filter exchange tool (Figures 3-10, 3-11 and 3-24). The tines of the fork should straddle the hub of the filter base.**

    NOTE: TEOM filters must be preconditioned to avoid excessive moisture buildup prior to their use in the system (Section 3.1.3).

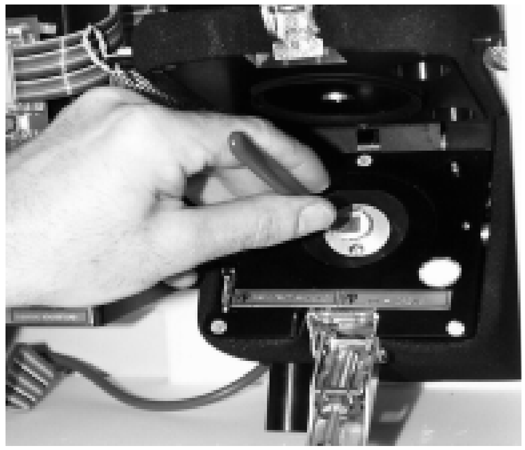


Figure 3-22. Removing a TEOM filter.

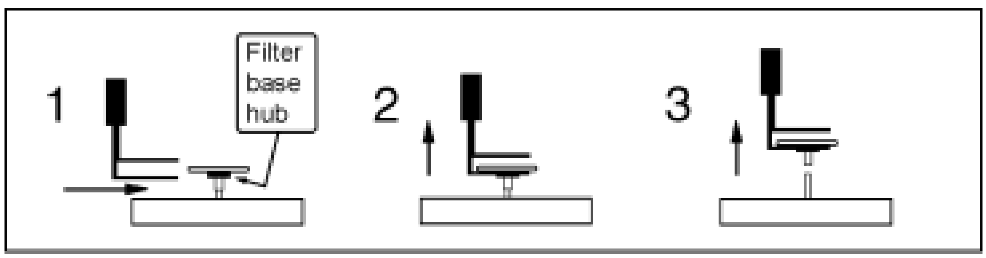


Figure 3-23. Filter removal.

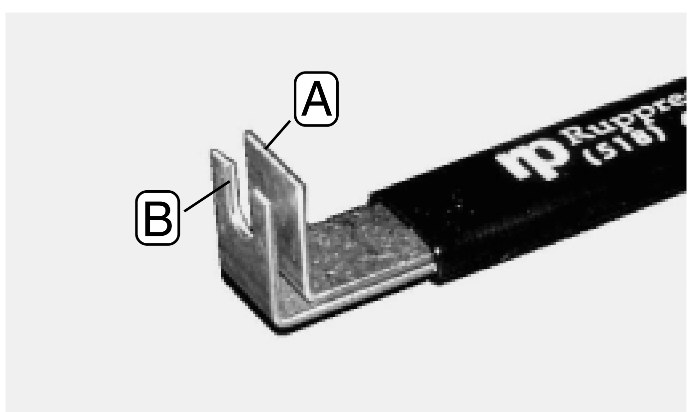


Figure 3-24. Close-up of the filter exchange tool with the upper tab (A) and the fork (B) highlighted.

11) Gently pull straight up, lifting the TEOM filter from the tapered element (TE) (Figure 3-23). Do not twist or tilt the filter exchange tool from side-to-side while removing the filter from the TE. This will damage the TE.

3.2. 47 mm Filter Installation

The user should install a new 47 mm filter into the 8500 module before running the first sample run, and every time that you install a new TEOM filter into the Series 1400a sensor unit (Section 3.3).

Follow these steps to install the 47 mm filter:

1) Locate the 8500 module (Figure 3-25).

Figure 3-25. 8500 module.

2) Open the small filter door located on the side of the 8500 module (Figures 3-25 and 3-26).

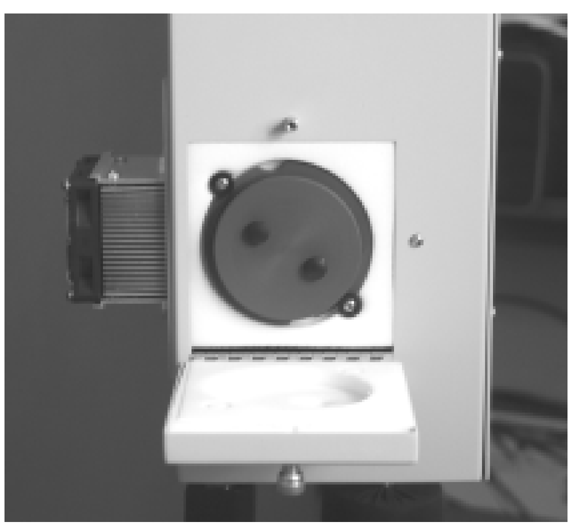


Figure 3-26. 8500 module with filter door open.

3) Unscrew and remove the filter holder (Figure 3-27).

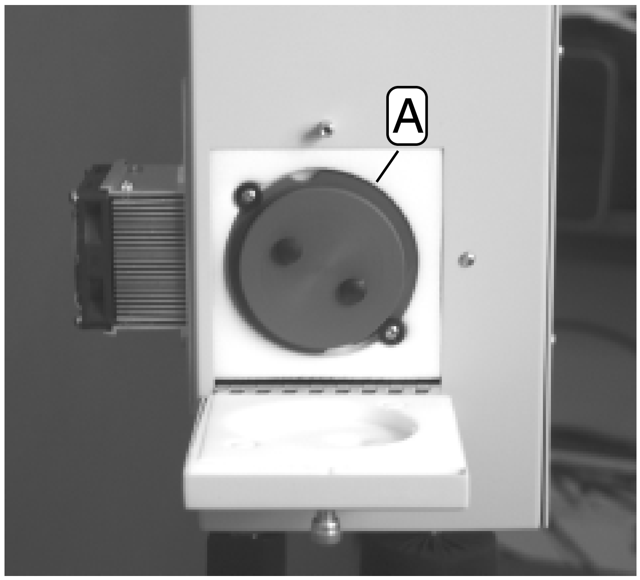


Figure 3-27. 8500 module with filter holder (A) highlighted.

4) Remove the filter holder from the filter holder (Figure 3-28).

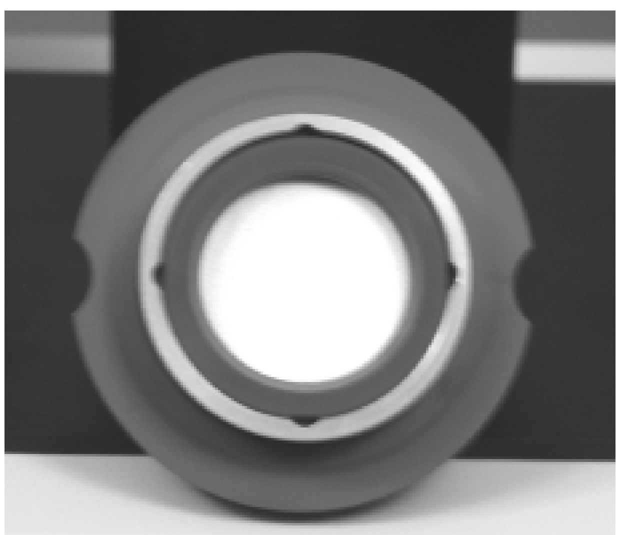


Figure 3-28. Filter installed in filter holder.

5) Locate a blue filter cassette and a 47 mm filter (Section 2.2).

6) Open the filter cassette and insert a 47 mm filter into the cassette (Figures 3-29 and 3-30). Be sure to install the 47 mm filter into the cassette with the face of the filter paper facing the larger side of the cassette.

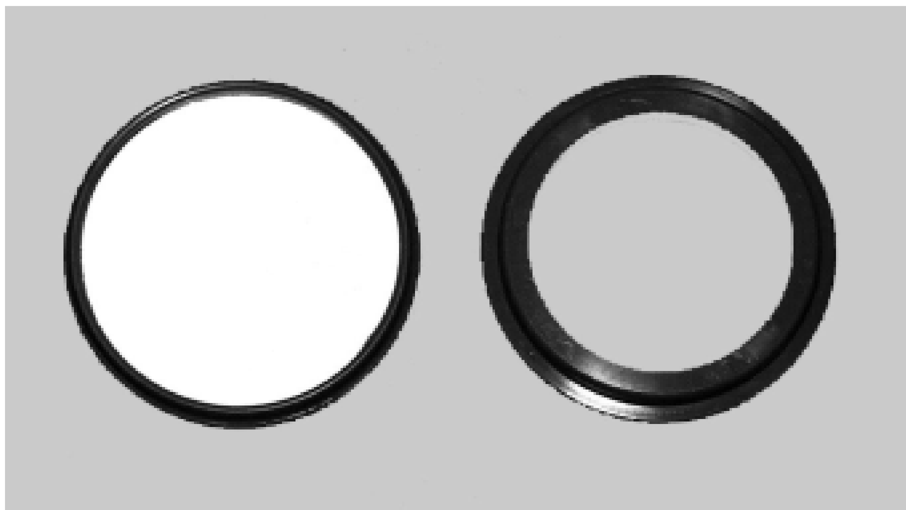


Figure 3-29. Open filter cassette with a 47 mm filter installed inside the small section of the cassette.

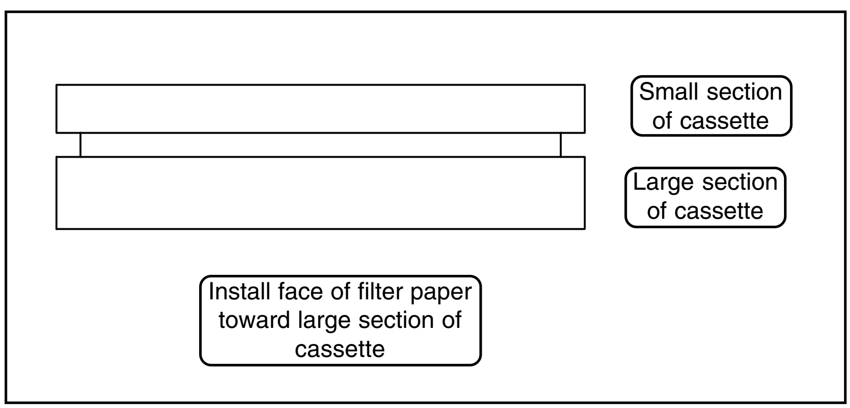


Figure 3-30. Side view drawing of a filter cassette.

7) Close the filter cassette (Figure 3-31).

Figure 3-31. Closing the filter cassette.

8) Install the small section of the cassette into the filter holder (Figures 3-28 and 3-32). Be sure to press the filter cassette into the filter holder until it snaps into place.

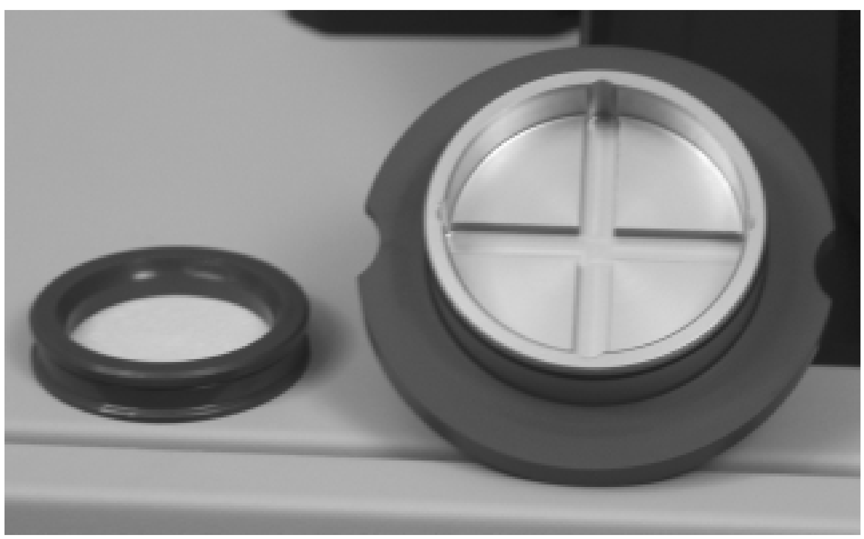


Figure 3-32. Filter holder and filter cassette.

9) Install the filter holder into the filter holder.

10) Close the filter door.

3.3. Filter Loading

The filter loading percentage value indicates the fraction of the TEOM filter's total capacity that has been used. You can check the TEOM filter loading percentage on the monitor's Main screen (Figure 3-33). Because this value is determined by the pressure drop of the main sample flow line, the instrument always shows a non-zero value even if no TEOM filter is mounted in the mass transducer. New TEOM filters generally exhibit filter loading percentages of 15% to 30% at a main flow rate of 3 l/min, and less at lower flow rates.

Figure 3-33. Main screen with filter loading percentage highlighted.

Filter loading percentage

```
OK     4+  21%  NU     09:39
Mass Conc               11.5
01-Hr MC                12.5
08-Hr MC                 8.3
```

TEOM filters must be replaced before the filter loading percentage reaches 100% to ensure the validity of the data generated by the instrument (Figure 3-34). At some point above 100%, the main flow drops below its set point.

Figure 3-34. Main screen showing that filter replacement is required.

Status condition

Filter loading percentage

```
X      4+  91%  NU   09:45
Mass Conc>            11.5
01-Hr MC              12.7
08-Hr MC               9.2
```

If the filter loading percentage is higher than 30% (at a main flow rate of 3 l/min) when a new TEOM filter is placed on the mass transducer, or if the lifetime of consecutive TEOM filters becomes noticeably shorter, you may need to replace the in-line filter in the main flow line (Section 12).

Testing performed for official U.S. EPA PM-10 measurements must be conducted with TEOM filters (Section 2.2) made of Teflon-coated, glass-fiber filter paper. Filters should be stored inside the sensor unit for easy access and to keep them dry and warm (Section 3.1.3).

3.3.1. Filter Life

TEOM filter life depends upon the nature and concentration of the particulate matter sampled, as well as the main flow rate setting. TEOM filters must be replaced when the filter loading value approaches 100%. This generally corresponds to a total mass accumulation on the filter of approximately 3-5 mg. TEOM filter life at a main flow rate of 3 l/min is generally 21 days at an average PM-10 concentration of 50 µg/m^3. TEOM filter life is longer at lower flow rates because the particulate matter accumulation on the TEOM filter is slower.

3.3.2. When to Replace TEOM and 47mm Filters

TEOM filters must be replaced before the filter loading percentage on the status line of the Main screen reaches 100%. When the filter loading percentage is greater than 90%, the “CHECK STATUS” light (located below the “POWER” button on the front of the TEOM control unit) (Figure 3-35) lights up and the status condition code (Section 7) on the status line of the Main screen changes from “OK” to “X” (Figure 3-34). You must replace the 47 mm filter (Section 3.2) every time that you replace a TEOM filter.

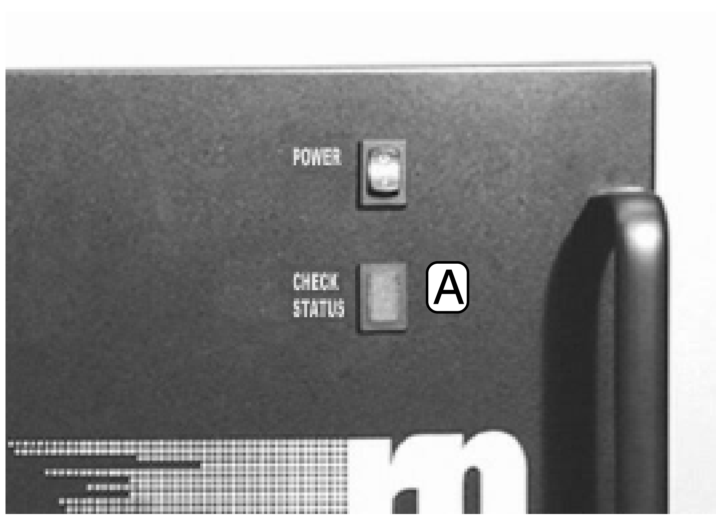


Figure 3-35. Control unit with the “CHECK STATUS” light (A) highlighted.

3.4. Turning On the Series 8500 FDMS Monitor

Follow these steps to turn on the monitor:

1) **Supply power to the instrument at the appropriate voltage (Section 2.3.1).**

2) **Press the "POWER" switch on the front panel of the control unit (Figure 3-36). The Title screen will appear on the control unit's display (Figure 3-37). After a moment, the Main screen (Figure 3-38) will display.**

Figure 3-36. Control unit with the "POWER" button (A) highlighted.

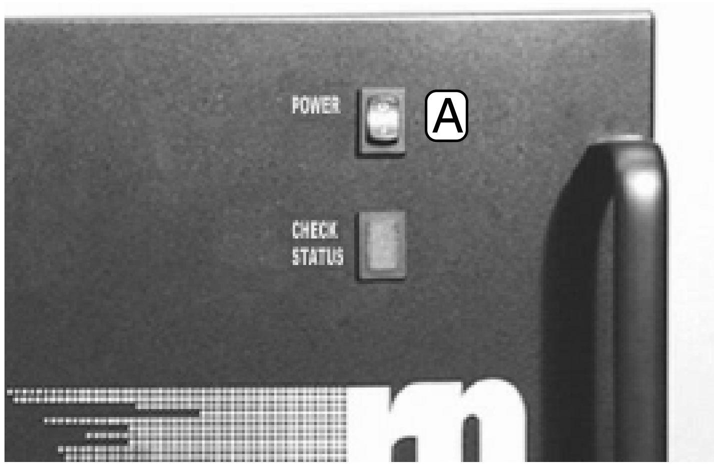


Figure 3-37. Title screen.

```
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```

Figure 3-38. Main screen.

```
OK     4+  21%  NU     09:39
Mass Conc               11.5
01-Hr MC                12.5
08-Hr MC                 8.3
```

3) Plug the pump (Figure 3-17) into an appropriate power source to draw a sample stream through the system.

Once the power switch is pressed, the “CHECK STATUS” light (Figure 3-35) will light because the flow rates and temperatures are outside of tolerance ranges. The “CHECK STATUS” light will remain lit during the first 30 minutes after the power switch is pressed while the monitor warms up. The status light automatically turns off after all flow rates and temperatures reach tolerance ranges (Section 3).

The flow controllers inside the control unit make a slight “clicking” sound when the instrument is turned on. The instrument automatically resets itself when it is turned on. As part of this initialization procedure, the monitor waits until the flow rates and temperatures stabilize within a narrow range (Section 6) for 30 minutes before starting data collection. This ensures the validity of all data points computed by the system.

> NOTE: Upon initial instrument start up, the values in the mass concentration fields are the running averages that are accumulated until a 1-hour time period has passed. The values are visible to provide the user with an indication that the instrument is functioning, after instrument power up or reset. These raw values are used for internal calculations only.

3.5. Leak Check

Follow these steps to perform a leak check:

1) **Plug the pump (Figure 3-17) into an appropriate power source to draw a sample flow through the system.**
2) **Remove the TEOM filter from the mass transducer according to the instructions in Section 3.1.4.**

   IMPORTANT: DO NOT remove the 47 mm filter and filter cassette from the 8500 module.

3) **Press the "POWER" switch to turn on the control unit (Figure 3-36).**
4) **When in the Main screen (Figure 3-38), press the up (<↑>) and down (<↓>) arrow keys to display the main flow and auxiliary flow values on the four-line display (Figure 3-39).**

Figure 3-39. Main screen with main and auxiliary flow rates displayed.

```
OK     4+  21%  NU     09:44
Main Flow               3.00
Aux Flow               13.66
---------<
```

5) **Locate the flow audit adapter (Figure 3-40), which is contained in the flow audit adapter kit.**

Figure 3-40. Flow audit adapter with valve open.

6) Ensure that the valve of the flow audit adapter is in its open position (Figure 3-40).

7) Remove the sample inlet from the flow splitter (Section 2) and replace it with the flow audit adapter (Figure 3-41).

Figure 3-41. Flow audit adapter installed on flow splitter with valve open.

8) Close the valve of the flow audit adapter (Figure 3-42).

Figure 3-42. Flow audit adapter installed on flow splitter with valve closed.

9) When in the Main screen, the main flow reading should read less than 0.15 l/min and the auxiliary flow reading should read less than 0.60 l/min. If the main flow reading is less than 0.15 l/min and the auxiliary flow reading is less than 0.60 l/min, go to step 18. If the main flow reading is greater than 0.15 l/min and the auxiliary flow reading is greater than 0.60 l/min, check the hose fittings and other critical connections in the flow system for leaks and repeat steps 7-8, and then go to step 10.

10) After you check the hose fittings and other critical connections in the flow system for leaks and repeat steps 7-8, check the main flow reading and the auxiliary flow reading on the Main screen. Go to step 11.

11) When in the Main screen, the main flow reading should read less than 0.15 l/min and the auxiliary flow reading should read less than 0.60 l/min. If the main flow reading is less than 0.15 l/min and the auxiliary flow reading is less than 0.60 l/min, go to step 18. If

the main flow reading is greater than 0.15 l/min and the auxiliary flow reading is greater than 0.60 l/min, you must repeat the leak check procedure using an offset value to account for the characteristic non-linearity of the mass flow sensor for flow values near 0 l/min. Go to step 12.

12) **To determine the non-linearity offset value (NOV), *slowly* open the valve located on the flow audit adapter (Figure 3-41) and disconnect or unplug the vacuum pump.**

    IMPORTANT: Be sure to open the valve on the adapter *slowly* to gradually release the vacuum in the system.

13) **Wait 1 minute and observe the main flow and auxiliary flow readings. These are the NOVs for both the main flow and auxiliary flow. Record these values.**

14) **Plug in or reconnect the vacuum pump, and wait 3-5 minutes to allow the main flow and auxiliary flow to stabilize.**

15) **When both flow rates have stabilized, close the valve on the flow audit adapter (Figure 3-42).**

16) **When in the Main screen, the main flow reading should read less than 0.15 l/min plus the main flow NOV, and the auxiliary flow reading should read less than 0.60 l/min plus the auxiliary flow NOV. For example, if the NOV for the main flow was recorded as 0.08 l/min, add 0.08 to 0.15 for a total of 0.23 (0.08 + 0.15 = 0.23). The main flow reading should be less than 0.23 l/min. If the NOV for the auxiliary flow was recorded as 0.12 l/min, add 0.12 to 0.60 for a total of 0.72 (0.12 + 0.60 = 0.72). The auxiliary flow reading should be less than 0.72 l/min.**

17) **If the flow readings exceed these calculated values (the NOVs plus 0.15 l/min for the main flow and 0.60 for the auxiliary flow), perform an analog board calibration and mass flow controller calibration (refer to service manual). This also may indicate that there is a faulty connection or component (such as the mass flow controller or the vacuum pump) in the system. If the flow readings do not exceed these calculated values, go to step 18.**

✘ CAUTION: SLOWLY open the valve on the flow audit adapter to gradually release the vacuum in the system.

18) **Slowly open the valve located on the flow audit adapter.**

    IMPORTANT: Before removing the flow audit adapter, open the valve on the adapter slowly to gradually release the vacuum in the system.

19) **Remove the flow audit adapter from the flow splitter.**

20) **Install the sample inlet onto the flow splitter (Section 2).**

21) Replace the TEOM filter in the mass transducer (Sections 3.1.4 and 3.1.2).

22) Close the mass transducer and the sensor unit door.

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Section 4: Software Overview

This section describes the steps involved in navigating through the basic screens of the Series 8500 FDMS Monitor and interacting with the unit. Follow the procedures outlined in Sections 2 and 3 before attempting to operate the monitor.

4.1. Title Screen

When the user presses the power switch (Figure 4-1) of the Series 1400a control unit, the Title screen (Figure 4-2) momentarily appears on the instrument's display to identify the model number of the unit and copyright date (Figure 4-2).

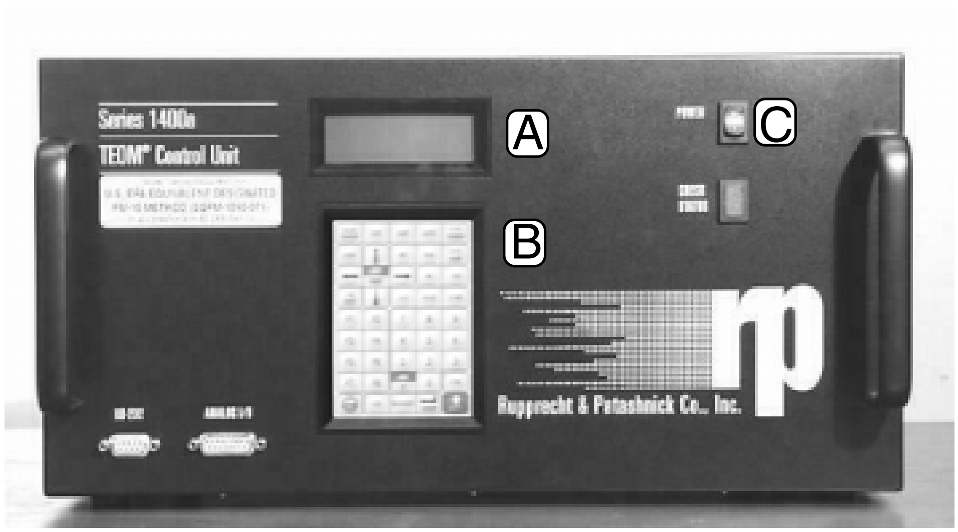

Figure 4-1. Front panel of TEOM control unit with the four-line display (A), keypad (B), and POWER button (C) highlighted.

Figure 4-2. Title screen.

```
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```

4.2. Main Screen

The Main screen (Figure 4-3) shows information regarding the existence of any status conditions, the current operating mode and certain operational information. This screen is divided into two sections: the status line at the top of the screen and three information lines below the status line (Figures 4-3 and 4-4).

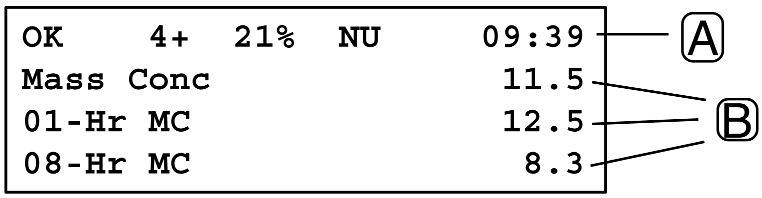


Figure 4-3. Main screen with the status line (A), and information lines (B) highlighted.

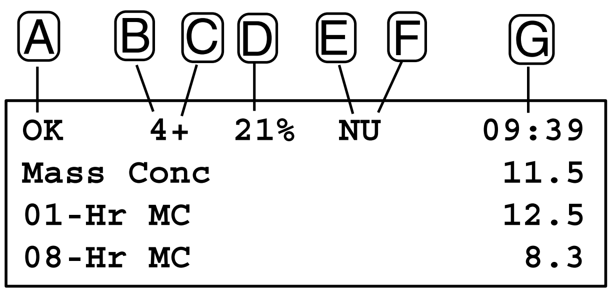


Figure 4-4. Main screen with the current status condition (A), current operating mode (B), status watch (A/I 1 Mode) (C), filter loading percentage (D), current RS232 mode (E), protection level (F) and current time (G) highlighted.

If the Main screen is not currently displayed on the control unit's four-line display, you can display the Main screen in two different ways:

1. Press the <MAIN/STATUS> key on the control unit's keypad.
2. Press the <1> key, the <8> key, and then press the <ENTER> key (Section 4.3.1).

4.2.1. Status Line

The status line (Figure 4-4) of the Main screen provides a summary of the current operational conditions of the instrument.

The status line contains the following information:

OK — This field contains the current status condition. It is an alphanumeric code that summarizes the operational status of the instrument, indicating whether any status condition exists. Refer to Section 7 for an explanation of the unit's status codes.

4 — This field contains the unit's current operating mode. It indicates the instrument's current operational setting and the type of data being computed by the monitor. The operating modes are: Operating Mode 1 ("1"), Operating Mode 2 ("2"), Operating Mode 3 ("3"), Operating Mode 4 ("4"), Setup Mode ("S") and Stop All Mode ("X") (Section 6).

+ — This field contains the status of analog output channel 1 (A/O 1). If the "A/O 1" field of the Main screen status line is blank, analog output 1 is operating in its usual fashion (Section 9). If the A/O 1 field contains a "+", analog output 1 is being used as a status watch indicator. When defined in this fashion, analog output 1 transmits a full scale signal (for example, 10 VDC if the channel is configured for 10 VDC operation) if a status condition exists in the temperatures, flows or oscillation of the mass transducer. If no such status condition exists, analog output channel 1 operates in its usual fashion (Section 10). When in the Main screen, press the <F5> key to display the "+" in the A/O 1 field and use the analog output channel 1 as a status watch indictor.

21%	This field contains the filter loading percentage (Section 3). It indicates the portion of the TEOM filter's total capacity that has been used. Because this value is determined by the pressure drop of the main (sample) flow line, the instrument will always show a nonzero value even if no filter is mounted in the mass transducer. New filters generally exhibit filter loading percentages of 15% to 30% at a main flow rate of 3 l/min, and less at lower flow rates. TEOM filter cartridges must be exchanged before this value reaches 100% to ensure the validity of the data generated by the instrument. At some point above 100%, the main flow drops below its set point. If the filter loading percentage is higher than 30% (at a main flow rate of 3 l/min) when a new TEOM filter is placed on the mass transducer, or if the lifetime of consecutive TEOM filter cartridges becomes noticeably shorter, inspect the in-line filter in the main flow line (Section 12) and replace it, if necessary.
N	This field contains the RS232 mode. It defines the current function of the 9-pin RS232 connectors on the front and back panels of the TEOM control unit. You can select the RS232 mode when in the Set RS-232 Mode screen (Section 9).

IMPORTANT: Never connect serial devices to the front and back RS232 ports of the instrument at the same time. This can cause the RS232 features of the monitor to malfunction.

U	This field contains the protection indicator (Section 11) of the Series 8500 FDMS Monitor. It incorporates three states of password protection: Unlocked Mode ("U"), Low lock Mode ("L"), High lock Mode ("H").
09:39	This field contains the current time (hh:mm). Refer to Section 6 for instructions on changing the time and date stored by the instrument.

4.2.2. Information Lines

The Main screen contains more information lines than can be viewed at one time. Press the down (<↓>) arrow key on the control unit's keypad (Figure 4-1) to view the additional information lines (Figure 4-5).

Figure 4-5. Main screen with additional information lines displayed.

```
OK     4+  21%  NU    09:39
Mass Conc              11.5
01-Hr MC               12.5
08-Hr MC                8.3
---------------------------
24-Hr MC               69.3
Tot Mass             974.38
Case Temp             30.00
Air Temp              30.01
Cap Temp              29.98
Main Flow              3.00
Aux Flow              13.66
---------<
Noise                 0.524
Frequency         245.55603
```

When you press the down arrow key to view additional information lines, the status line remains visible at the top of the screen. Because the Main screen displays data computed by the instrument, none of the data values on this screen can be edited or changed by the user.

> NOTE: Upon initial instrument start up, the values in the mass concentration fields are the running averages that are accumulated until a 1-hour time period has passed. The values are visible to provide the user with an indication that the instrument is functioning, after instrument power up or reset. These raw values are used for internal calculations only.

The information lines contain the following information:

Mass Conc	This field contains the mass concentration value. The unit calculates the mass concentration (MC) value by subtracting the Ref MC from the Base MC (Section 7). This value cannot be changed by the user.
01-Hr MC	This field contains the 1-hour mass concentration average (μg/m^3). This is a sliding average that is updated every 60 minutes on the hour. This value cannot be changed by the user.
08-Hr MC	This field contains the 8-hour mass concentration average (μg/m^3). This is a sliding average that is updated every 60 minutes on the hour. This value cannot be changed by the user.

NOTE: Mass concentration averages of less than 24 hours can be averaged using data logging equipment to compute sliding 24-hour averages and 24-hour averages that do not necessarily start and end at midnight, as well as averages on other user-defined time scales.

24-Hr MC	This field contains the 24-hour mass concentration average (μg/m^3). This is a sliding average that is updated every 60 minutes on the hour. This value cannot be changed by the user.
Tot Mass	This field contains the amount of mass that has accumulated on the TEOM filter since the last instrument reset which is done by turning on the instrument or pressing the <F1> or <RUN> key. This value cannot be changed by the user.
Case Temp	This field contains the temperature of the TEOM mass transducer case (set point = 30° C, ±0.1° C). This value cannot be changed by the user.
Air Temp	This field contains the temperature of the sample stream at the base of the heated air inlet (set point = 30° C, ±0.5° C). This value cannot be changed by the user.

Cap Temp	This field contains the temperature of the upper part of the TEOM mass transducer (set point = 30° C, ±0.1° C). This value cannot be changed by the user.
Main Flow	This field contains the actual volumetric flow rate measured by the main flow controller (set point = 3 l/min). This value cannot be changed by the user.
Aux Flow	This field contains the actual volumetric flow rate measured by the auxiliary flow controller (set point = 13.67 l/min). This value cannot be changed by the user.
Noise	This field contains the mass transducer's performance. This value should be less than "0.10" after the system has been in Operating Mode 4 for at least 30 minutes. This value cannot be changed by the user.
Frequency	This field contains the oscillating frequency of the tapered element (TE) in the mass transducer. This value varies from one Series 1400a sensor unit to another, but generally ranges between 150 and 400 Hz. This value cannot be changed by the user.

4.3. Navigating Among Screens

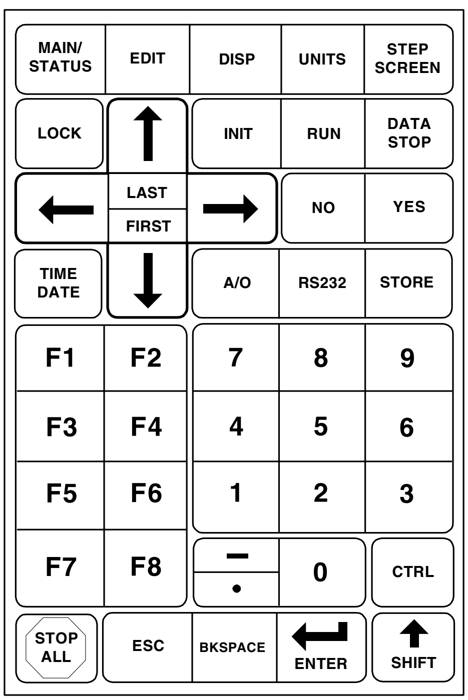
The Series 8500 FDMS Monitor incorporates menu-driven software that provides the user with direct instrument control from the keypad of the control unit. This section explains how to interact with the instrument, view information and change the values of system parameters.

4.3.1. Keypads

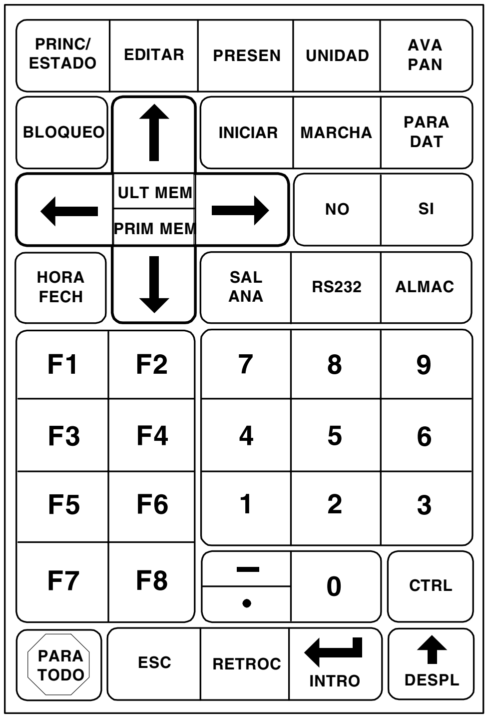
The user can access the monitor's software screens by pressing keys on the keypad. R&P supplies the Series 8500 FDMS Monitor with a choice of keypad languages. The languages available at the present time are English (Figure 4-6), Spanish (Figure 4-7) and German (Figure 4-8).

Some of the screens on the Series 8500 FDMS Monitor can be displayed by pressing different keys on the keypad, depending on which screen is currently shown on the unit's four-line display (Figure 4-1).

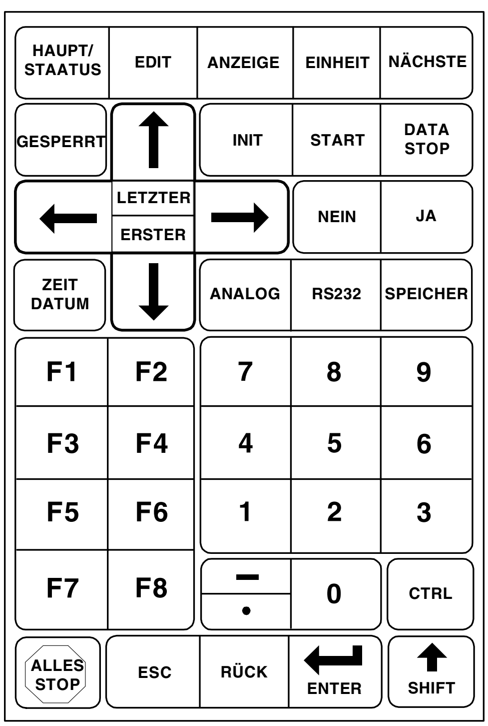
Figures 4-6. English language keypad.



Figures 4-7. Spanish language keypad.



Figures 4-8. German language keypad.

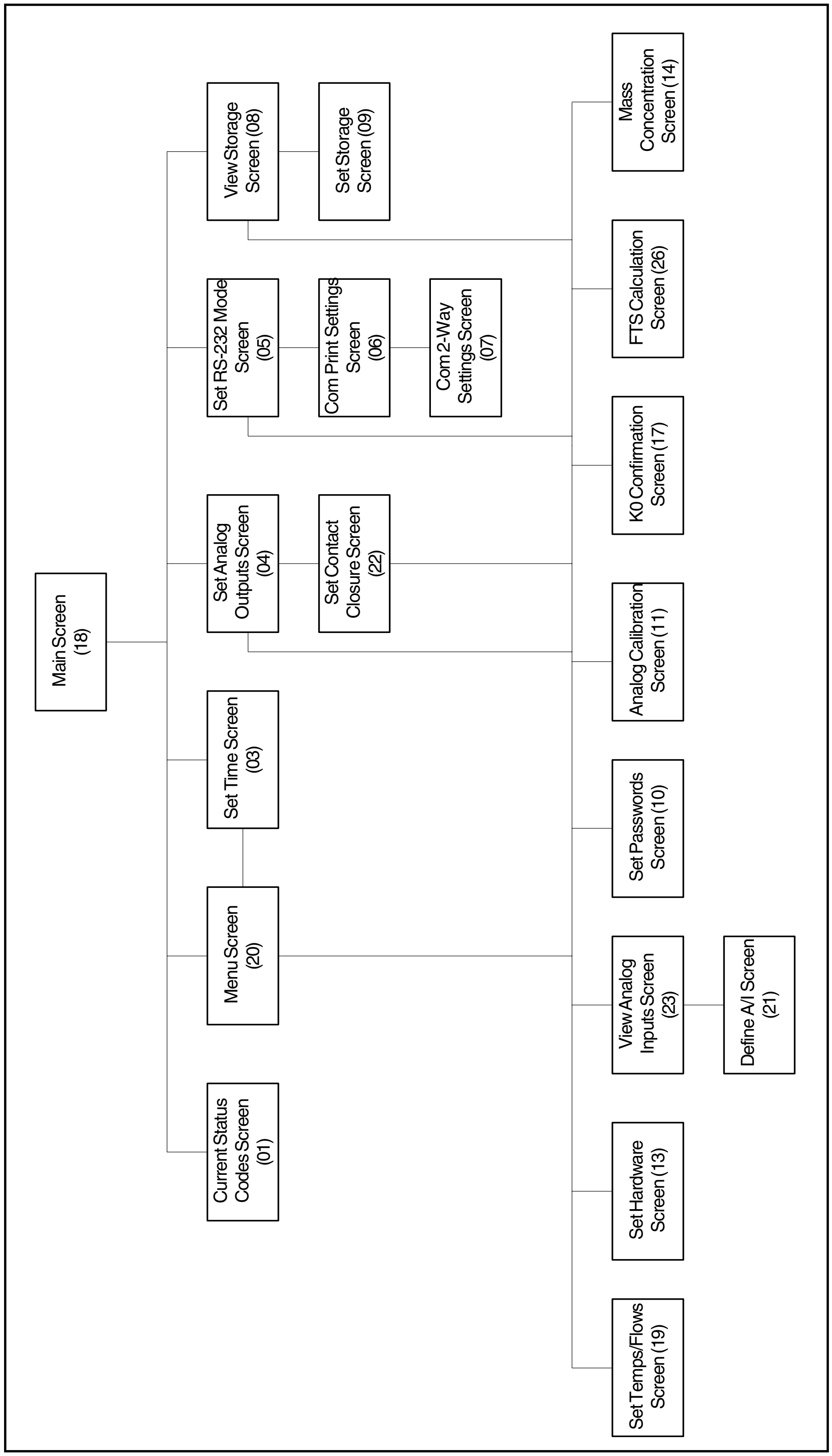


When in the Main screen (Figure 4-3), the following screens can be accessed directly by pressing a key on the unit's keypad:

<MAIN/STATUS> key	Current Status Codes screen (Section 7)
<STEP SCREEN> key	Menu screen (Section 4.3.3)
<TIME/DATE> key	Set Time screen (Section 6)
<A/O> key	Set Analog Outputs screen (Section 9)
<RS232> key	Set RS-232 Mode screen (Section 9)
<STORE> key	View Storage screen (Section 8)

Additionally, any screen can be displayed by entering its "screen number" from the keypad and pressing the <ENTER> key. The two-digit screen number for each screen is shown in Figure 4-9. For example, the screen number of the Main screen is "18." You can display the Main screen by pressing the <1> key, the <8> key and then the <ENTER> key.

Figures 4-9. Hierarchy of software screens.

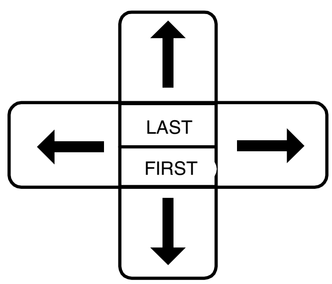


4.3.2. Positioning the Cursor

Many of the monitor’s screens have several lines of information that cannot be seen when the screen is displayed on the four-line display.

Press the up (<↑>) and down (<↓>) arrow keys (Figures 4-6 and 4-10) to move the cursor on the screen up or down one line at a time. To move the cursor up six lines, press the <SHIFT> key and hold it down while pressing the up (<↑>) arrow key. To move the cursor down six lines, press the <SHIFT> key and hold it down while pressing the down (<↓>) arrow key. To move the cursor to the first line of the screen, press the <CTRL> key and hold it down while pressing the up (<↑>) arrow key. To move the cursor to the last line of the screen, press the <CTRL> key and hold it down while pressing the down (<↓>) arrow key.

Figure 4-10. Keypad arrows.



4.3.3. MENU SCREEN

The user can access all of the monitor's screens directly or indirectly through the Menu screen (Figure 4-11).

Figure 4-11. Menu screen.

```
  LISTING OF SCREENS
> Set Temps/Flows
  Set Hardware
  View Analog Inputs
```

You can display the Menu screen on the four-line display of the control unit in two different ways:

1. When in the Main screen (Figure 4-3), press the <STEP SCREEN> key on the control unit's keypad.
2. Press the <2> and <0> keys, and then press the <ENTER> key.

The Menu screen contains more information lines than can be viewed at one time. Press the down (<↓>) arrow key on the control unit's keypad (Figure 4-1) to view the additional information lines (Figure 4-12).

Figure 4-12. Menu screen with additional information lines displayed.

```
  LISTING OF SCREENS
> Set Temps/Flows
  Set Hardware
  View Analog Inputs
  ------------------
  Set Time
  Set Analog Outputs
  Set Contact Closure
  Set RS-232 Mode
  View Storage
  Set Passwords
  Analog Calibration
  K0 Calibration
  FTS Calculation
  Mass Concentration
```

The following screens can be accessed through the Menu screen (Figure 4-12):

Set Temps/Flows screen (Section 6)
Set Hardware screen (Section 6)
View Analog Inputs screen (Section 9)
Set Time screen (Section 6)
Set Analog Outputs screen (Section 9)
Set Contact Closure screen (Section 9)
Set RS-232 Mode screen (Section 9)
View Storage screen (Section 8)
Set Passwords screen (Section 11)
Analog Calibration screen (Section 12)
K0 Confirmation screen (Section 12)
FTS Calculation screen (Section 12)
Mass Concentration screen (Section 7)

Follow these steps to view an instrument screen through the Menu screen:

1) **When in the Main screen (Figure 4-3), press the <STEP SCREEN> key to display the Menu screen (Figure 4-11). You also can press the <2> and <0> keys, and then press the <ENTER> key to display the Menu screen.**
2) **When in the Menu screen, press the up (<↑>) or down (<↓>) arrow keys to move the cursor to the name of the screen that you want to view.**
3) **Press the <STEP SCREEN> key, or the <ENTER> key, to display the desired screen.**
4) **Press the <MAIN/STATUS> key, or the <ESC> key, to return to the Main screen.**

When the monitor is displaying certain screens, additional related screens can be displayed by pressing the <STEP SCREEN> key. For example, if the monitor is displaying the Set Analog Ouputs screen (Section 9), and the user presses the <STEP SCREEN> key, the unit will now display the Set Contact Closure screen (Section 9). However, when the unit is displaying a screen that does not have an additional related screen and the user presses the <STEP SCREEN> key, the unit will display the Main screen.

If the monitor is displaying any screen except the Main screen, and the user presses the <MAIN/STATUS> key, the monitor will display the Main screen.

4.3.4. EDIT KEY

The monitor is normally in the “Display” or “Browse” Mode, which allows the user to move from screen to screen to view the system’s operating parameters. However, in a number of screens, the user may change the unit’s operating parameters. To change the unit’s operating paramaters, the user must enter the “Edit” Mode.

When you are in a screen that has values that can be changed or edited, press the up (<↑>) and down (<↓>) arrow keys to select the field to be edited. Then press the <EDIT> key on the monitor’s keypad to enter the Edit Mode. A “?” will appear on the screen in place of the “>” cursor. Edit the system parameter and then press the <ENTER> key to save the change. Press the <ESC> key to exit the Edit Mode while in any screen.

In certain cases, the instrument will beep when the <EDIT> key is pressed. The monitor will beep for three different reasons: the selected variable cannot be changed or edited, the selected variable can be edited only when the monitor is in the Setup Mode, the monitor is in the low lock or high lock mode (Section 12).

If the monitor is displaying a screen that can be edited, and the monitor beeps when the user presses <EDIT> key, then the user must press the <DATA STOP> key to enter Setup Mode before attempting to edit a variable.

If the monitor is in the low lock or high lock mode (Section 12), and the user attempts to edit a variable by pressing the <EDIT> key, the cursor will not change to a “?” and the monitor will not beep.

New values can be entered in one of two ways:

Direct keypad entry — Display the screen that has the operating parameters that you want to change or edit. Press the <EDIT> key. Enter a new value directly by pressing the number keys, including the minus sign and decimal point keys, if necessary, (Figure 4-5). Then press the <ENTER> key to save the change. If you make a mistake while entering the changes on the monitor’s keypad, press the <BKSPACE> key to erase individual characters or the <ESC> key to leave the edit command. You also can use direct keypad entry to enter program register codes (PRCs) (Appendix B). For example, to set the value for “AO1 Var” to the 24-hour mass concentration average in the Set Analog Outputs screen, press the <EDIT> key, <0>, <6>, <0>, and then the <ENTER> key to save the change.

Arrow keys	Display the screen that has the operating parameters that you want to change or edit, and press the <EDIT> key. Press the up (<↑>) and down (<↓>) arrow keys to increase or decrease the value of the variable being edited. To increase the value of the variable by 10 steps at a time, press the <SHIFT> key and hold it down while pressing the up (<↑>) arrow key. To decrease value of the variable by 10 steps at a time, press the <SHIFT> key and hold it down while pressing the down (<↓>) arrow key. To increase the value of the variable by 100 steps at a time, press the <CTRL> key and hold it down while pressing the up (<↑>) arrow key. To decrease the value of the variable by 100 steps at a time, press the <CTRL> key and hold it down while pressing the down (<↓>) arrow key. Press the <ENTER> key to save the change. Using the up and down arrow keys to change a variable is very convenient when changing a variable that is not entirely numeric. For example, when in the Set Analog Outputs screen (Section 9), you can press the <EDIT> key, the up (<↑>) arrow key and then the <ENTER> key to change the value of “AO2 Var” from “01-Hr MC” to “08-Hr MC.” It is generally a good practice to use the up (<↑>) and down (<↓>) arrow keys to change the value of alphanumeric variables, such as the “Month” value in the Set Time screen, and “Max Volt” and “Jumpers” values in the Set Analog Outputs screen.

In certain cases, two editable variables may appear on the same line. For example, in the Set Temps/Flows screen (Section 6), the average and standard temperature variables (“T-A/S”) are on the same line. If you want to change the value of these variables, make sure the Set Temps/Flows screen is displayed on the control unit’s four-line display. When in the Set Temps/Flows screen, press the press up (<↑>) and down (<↓>) arrow keys to move the cursor to the T-A/S field, and press the <EDIT> key. A “?” will appear next to both editable variables on the current display line. Press the left (<←>) or right (<→>) arrow keys to choose which variable to change. This causes one of the two “?” indicators to disappear, leaving only one “?” next to the selected variable. Enter the new value by pressing the appropriate numbers on the control unit’s keypad.

If the “?” edit indicator is shown on the screen and there is no keypad activity for 10 seconds, the cursor will automatically return to the “>” cursor.

4.3.5. Display Key

The display (<DISP>) key (Figure 4-6) allows the user to change the variables that are displayed on the Main screen. When in the Main screen, press the up (<↑>) and down (<↓>) arrow keys to move the cursor to the line on which you want the new variable to appear, and press the <DISP> key. After you press the <DISP> key, a "#" will appear in place of the ">" cursor to indicate that the instrument is waiting for the input of a program register code (PRC) (Appendix B) (Figure 4-13). Enter the three-digit PRC for the new variable that you want to be displayed and press the <ENTER> key.

Figure 4-13. Main screen with the "#" cursor displayed.

```
OK     4+  21%  NU     09:51
Mass Conc#              11.5
01-Hr MC                12.5
08-Hr MC                 8.3
```

For example, to bring the current value for the instrument calibration constant to the current line, press the <DISP> key, <0>, <4>, <2> and then the <ENTER> key. If you make a mistake while entering this sequence, press the <ESC> key.

Also, the arrow keys can be used to select a PRC after you press the <DISP> key. Press the up (<↑>) and down (<↓>) arrow keys to increase or decrease the value of the PRC by 1. To increase the PRC variable by 10 steps at a time, press the <SHIFT> key and hold it down while pressing the up (<↑>) arrow key. To decrease the PRC variable by 10 steps at a time, press the <SHIFT> key and hold it down while pressing the down (<↓>) arrow key. To increase the PRC variable to the highest numerical PRC possible, press the <CTRL> key and hold it down while pressing the up (<↑>) arrow key. To decrease the PRC variable to the lowest numerical PRC possible, press the <CTRL> key and hold it down while pressing the down (<↓>) arrow key. Press the <ENTER> key to save the change.

If the "#" cursor is shown on the screen and there is no keypad activity for 10 seconds, the cursor will automatically return to the ">" cursor.

4.3.6. Units Key

The <UNITS> key (Figure 4-6) switches the monitor's four-line display between displaying numbers and units of measure. If numeric values are shown on the display, press the <UNITS> key to display units of measure in place of the numbers (Figure 4-14). Conversely, select the <UNITS> key when units of measure are shown on the instrument to display numeric values.

Figure 4-14. Main screen with units of measure displayed.

```
OK     4+  21%  NU     09:45
Mass Conc>            ug/m^3
01-Hr MC              ug/m^3
08-Hr MC              ug/m^3
```

The instrument always returns the display to numeric values whenever the user changes to a new screen on the four-line display.

4.3.7. NO AND YES KEYS

The <NO> and <YES> keys (Figure 4-6) can serve two functions: changing a YES/NO value, or eliminating unwanted negative concentration values.

4.3.7.1. CHANGING A NO OR YES VALUE

Follow these steps to change the value of a NO or YES variable:

1) **Ensure that the appropriate screen is displayed on the control unit's four-line display.**
2) **Press the up (<↑>) or down (<↓>) arrow keys to move the cursor to the line that you want to edit or change.**
3) **Press the <EDIT> key.**
4) **Press the <NO> or <YES> key, or press the <0> key for "NO" or the <1> key for "YES." If you pressed the <NO> or <YES> key to change the value, you do not need to press the <ENTER> key after pressing the <NO> or <YES> key to save the change. However, if you pressed the <0> key for "NO" or the <1> key for "YES" to change the value, you must press the <ENTER> key to save the change.**

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Section 5: Basic Operation

This section explains how to program a sampling run, retrieve data after a sampling run in the field and verify your monitor's performance characteristics.

5.1. Programming the Monitor

This section describes the procedures for programming the Series 8500 FDMS Monitor for a sampling run. See Section 4 for more detailed information on navigating through the monitor's software screens.

Follow these steps to program the monitor for a sampling run:

1) **Install a TEOM filter into the mass transducer (Section 3).**
2) **Install a 47mm filter into the 8500 module (Section 3).**
3) **Press <DATA STOP> to ensure that the monitor is in the Setup Mode (Section 4).**
4) **Perform a leak check (Section 3).**
5) **In the Main screen (Figure 5-1), press <TIME DATE> on the keypad (Figure 5-2) to display the Set Time screen (Figure 5-3).**

Figure 5-1. Main screen.

```
OK     4+  21%  NU      09:39
Mass Conc                11.5
01-Hr MC                 12.5
08-Hr MC                  8.3
```

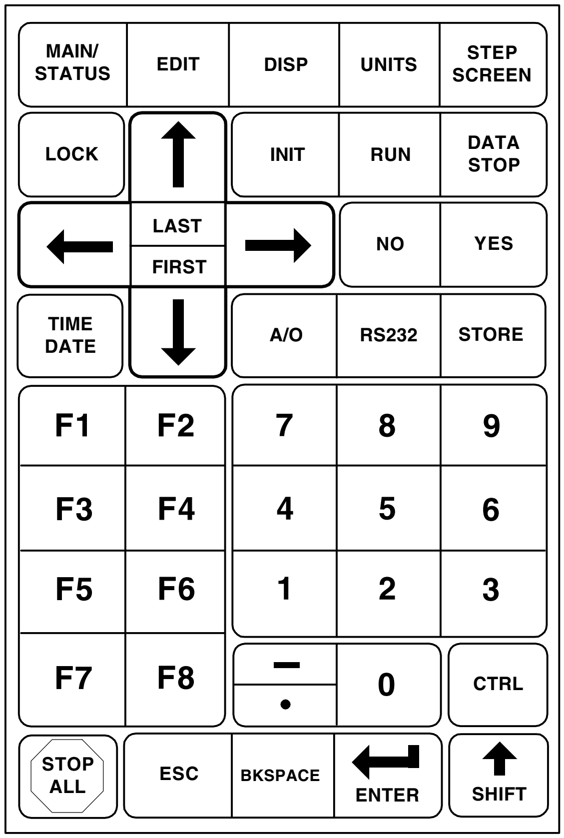


Figure 5-2. Control unit keypad.

Figure 5-3. Set Time screen.

```
         SET TIME
16:20:03          15-Jun-04
Second  >                 0
Minute                   20
```

6) **When in the Set Time screen, enter the current time and date in the appropriate fields (Section 5) and press <ENTER>. Press <ESC> to display the Main screen.**

7) **When in the Main screen, press <STEP SCREEN> on the keypad to display the Menu screen (Figure 5-4).**

Figure 5-4. Menu screen.

```
  LISTING OF SCREENS
> Set Temps/Flows
  Set Hardware
  View Analog Inputs
```

8) When in the Menu screen, ensure that the cursor is on “Set Temps/Flows” and press <ENTER>. The “Set Temps/Flows” screen (Figure 5-5) will now display.

Figure 5-5. Set Temps/Flows screen.

```
     SET TEMPS/FLOWS
T-Case>    30.00    30.00
T-Air      30.00    30.00
T-Cap      30.00    29.98
```

9) When in the Set Temps/Flows screen, determine how you want the monitor to report the mass concentration values: actual, seasonal or standard and enter the necessary parameters (Section 5). Enter the appropriate values for the main (SAMPLE) and auxiliary (BYPASS) flow adjustment factors, if necessary (Section 5). Press <ENTER> to save your changes.

10) Press <STEP SCREEN> to display the Set Hardware screen (Figure 5-6).

Figure 5-6. Set Hardware screen.

```
       SET HARDWARE
Cal Const>          9605
Ser Num            22822
Wait Time           1800
```

11) When in the Set Hardware screen, check the unit serial number and calibration constant (Section 12) to ensure they are correct. If these values are correct, go to step 11. If these values are not correct, press <EDIT> and enter the correct parameters. Then press <ENTER> to save the changes. Go to step 12.

12) Press <STORE> to display the Set Storage screen (Figure 5-7).

Figure 5-7. Set Storage screen.

```
        SET STORAGE
Stor Var1       > 01-Hr MC
Stor Var2         24-Hr MC
Stor Var3         Samp Dew
```

13) When in the Set Storage screen, select the variables to be stored in the monitor's internal data logger, the number of data fields per record, and the interval at which records are stored (Section 5). Press <ENTER> to save the changes.

14) Press <RS232> to display the Set RS-232 Mode screen (Figure 5-8).

Figure 5-8. Set RS-232 Mode screen.

```
      SET RS-232 MODE
 Mode: None
>None
 Print On Line
```

15) When in the Set RS-232 Mode screen, select the appropriate protocol for controlling the unit remotely or downloading the stored data records (Section 9). Press <ENTER> to save the changes.

16) If operating the instrument remotely using the RPComm software program, refer to Section 10. If operating the instrument remotely using the AK Protocol or the German Ambient Network Protocol, refer to Section 9.4.5. If downloading data records using the Fast Store Out RS232 Mode, refer to Section 9.4.4.1. If downloading data records using the Print On Line RS232 Mode, refer to Section 9.4.4.2. If downloading data records using the Store to Print RS232 Mode, refer to Section 9.4.4.3. After you have set up the unit for downloading data, go to step 17.

17) If setting up the unit to receive an analog input, refer to Section 9. If setting up the unit to transmit analog outputs, refer to Section 9.2. If setting up the unit's contact closure circuits, refer to Section 9.3. If not setting up the unit to receive analog inputs, transmit analog outputs, or to use the unit's contact closure circuits, go to step 18.

18) If using the password function to control access to unit operation, refer to Section 11. If not using the unit password function, go to step 18.

19) Press <ESC> to display the Main screen.

20) Press <F1> or <RUN> to start data collection.

NOTE: Upon initial instrument start up, the values in the mass concentration fields are the running averages that are accumulated until a 1-hour time period has elapsed. The values are visible to provide users with an indication that the instrument is functioning after instrument power up or reset. These raw values are used for internal calculations only.

5.2. POST-SAMPLING VERIFICATION AND DATA RETRIEVAL

This section explains how to verify the sampling run status and retrieve the sampling run data. If using the RPComm software application to download data, refer to Section 10 for further instructions.

Follow these steps to verify the sampling run status and retrieve the sampling run data:

1) **Check the status line on the Main screen and note any status code other than “OK.” If there were any status codes other than “OK,” press <MAIN/STATUS> to display the Current Status Codes screen. When in the Current Status Codes screen, verify the validity of the sampling run (Section 7).**
2) **Connect the monitor to the personal computer with the 9-to-9 pin RS232 cable (Section 9).**
3) **To set the storage pointer to the first data record to be downloaded, go to step 4. If you do not want to move the storage pointer, go to step 7.**
4) **Press <STORE> on the keypad to display the View Storage screen (Figure 5-9).**

Figure 5-9. View Storage screen.

```
VIEW STORAGE          2056
16:20:03         15-Jun-04
>01-Hr MC             34.9
 24-Hr MC             12.3
```

5) **When in the View Storage screen, use the right and left arrow keys to move the storage pointer to the data record where you want the data download to begin (Section 8).**
6) **Press and hold the <CTRL> key, then press <LAST/FIRST>. This will move the storage pointer to the data record just before your “beginning” data record.**
7) **Initiate the data capture software (such as TEOMCOMM or RPComm) on your PC or other serial data recording device (such as a data logger).**

8) Set your data capture software to the “data capture” or “data download” function.

9) If the monitor has been previously set up for data transfer to a PC, go to step 14. If the monitor has not been previously set up for data transfer to a PC, go to step 10.

10) Press <RS232> to display the Set RS-232 Mode screen (Figure 5-8).

11) When in the Set RS-232 Mode screen, select the appropriate protocol for controlling the unit remotely or downloading the stored data records (Section 9). Press <ENTER> to save the changes.

12) Press <ESC> to return to the Main screen. Go to step 13.

13) If operating the instrument remotely using the RPComm software program, refer to Section 10. If operating the instrument remotely using the AK Protocol or the German Ambient Network Protocol, refer to Section 9.4.5. If downloading data records using the Fast Store Out RS232 Mode, refer to Section 9.4.4.1. If downloading data records using the Print On Line RS232 Mode, refer to Section 9.4.4.2. If downloading data records using the Store to Print RS232 Mode, refer to Section 9.4.4.3. After you have set up the unit for downloading data, go to step 14.

14) When the data download is complete, set the RS232 protocol to “None” (Section 9).

15) Disconnect the RS232 cable from the monitor and the PC or other serial data recording device.

16) If any status code conditions occurred during the data download procedure, press <MAIN/STATUS> to display the Current Status Codes screen (Section 7).

17) When in the Current Status Codes screen, check the status codes that are displayed.

18) Press <F1> or <RUN> to reset the unit’s status codes and start data collection.

5.3. Verification/Audit Procedures

Perform the ambient air temperature verification (Section 5.3.1), pressure verification (Section 5.3.2) and leak check (Section 3) before executing the flow verification procedure (Section 5.3.3).

5.3.1. Verifying Ambient Air Temperature

Follow these steps to verify the ambient air temperature:

1) **Press the <1> and <9> keys, and then press <ENTER> to display the Set Temps/Flows screen (Figure 5-10).**
2) **When in the Set Temps/Flows screen, locate the current ambient temperature reading (Section 5).**
3) **Determine the current temperature (°C) at the ambient temperature sensor using an external thermometer [°C = 5/9 x (°F - 32)].**
4) **Verify that the value of the "Amb Temp" field is within ± 2°C of the measured temperature. If this is not the case, perform the ambient temperature calibration procedure (Service Manual).**

Figure 5-10. Set Temps/ Flows screen with additional lines displayed.

```
      SET TEMPS/FLOWS
T-Case>    30.00    30.00
T-Air      30.00    30.00
T-Cap      30.00    29.98
F-Main      3.00     3.00
F-Aux      13.67    13.65
T-A/S      25.00    25.00
P-A/S      1.000    1.000
Amb Temp             23.4
Amb Pres            0.988
FAdj Main           1.000
FAdj Aux            1.000
```

5.3.2. VERIFYING AMBIENT PRESSURE

Follow these steps to verify the ambient pressure:

1) **Press the <1> and <9> keys, and then press <ENTER> to display the Set Temps/Flows screen (Figure 5-10).**
2) **When in the Set Temps/Flows screen, locate the current ambient pressure reading (Section 5).**
3) **Determine the current ambient pressure in mm Hg (absolute pressure, not corrected to sea level). Verify the monitor's ambient pressure by measuring the current ambient station pressure in mm Hg with an external measurement device.**
   - To convert from Atmospheres @ 0° C to mm Hg, multiply by 760.
   - To convert from millibars to mm Hg, multiply by 0.75012.
   - To convert from inches Hg @ 32° F to mm Hg, multiply by 25.4.
4) **Verify that the value of the "Amb Pres" field is within ±10 mm Hg of the measured ambient pressure. If this is not the case, perform the ambient pressure calibration procedure (Service Manual).**

5.3.3. Flow Audit Procedure

✔ Do not run a flow audit procedure during a valid sampling run.

It is recommended to perform the flow audit procedure before initiating the first sample run. The flow audit procedure checks the flow rates in the Series 8500 FDMS Monitor and can be done with minimal disturbance of the instrument's normal operating configuration. The tolerances in this audit procedure should not be confused with the tighter specifications outlined in the calibration procedures of the Service Manual.

Perform the ambient air temperature verification (Section 5.3.1), pressure verification (Section 5.3.2) and leak check (Section 3.4) before executing the flow verification procedure (Section 5.3.3).

Tools Needed: Flow audit adapter kit (57-001243)

Materials: None

Follow these steps to perform a flow audit:

1) Press <DATA STOP> on the control unit keypad.

NOTE: Any data generated by the instrument during this audit procedure are invalid. Therefore, do not run a flow audit procedure during a valid sampling run.

2) Remove the sample inlet from the flow splitter (Figure 5-11).

3) Locate the flow audit adapter (Figure 5-12).

Figure 5-11. Removing the PM-10 inlet.

4) Ensure that the valve of the flow audit adapter is in the open position (Figure 5-12).

Figure 5-12. Flow audit adapter with valve open.

5) Install the flow audit adapter onto the flow splitter (Figure 5-13).

Figure 5-13. Flow audit adapter installed on flow splitter with valve open.

6) When in the Main screen, press the up and down arrow keys until the "Main Flow" (SENSOR FLOW) and "Aux Flow" (BYPASS FLOW) lines display on the screen (Figure 5-14). These values represent the actual volumetric flows as measured by the monitor's flow controllers.

Figure 5-14. Main screen with "Main Flow" and "Aux Flow" lines displayed.

```
OK     4+  21%  NU      09:44
Main Flow                3.00
Aux Flow                13.66
---------<
```

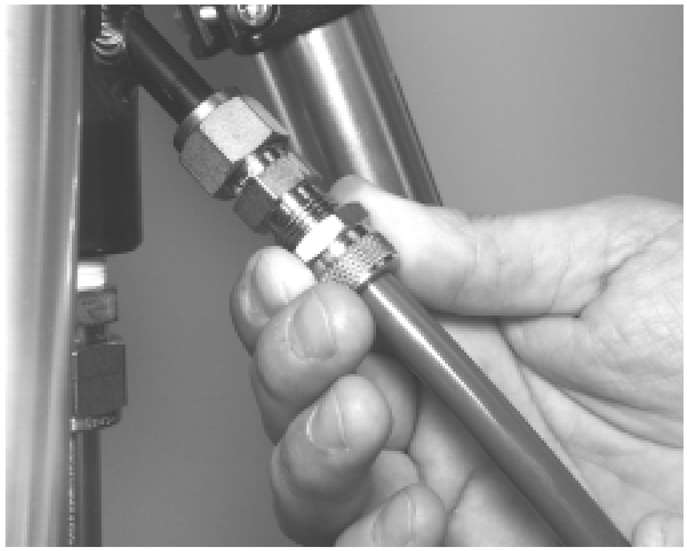
7) Confirm that these flows are within ±2% of their set points (3.0 l/min for the "Main Flow" and 13.67 l/min for the "Aux Flow"). Any greater deviation may indicate that the in-line filters are plugged or other blockages exist in the system.

8) Attach a reference flow meter such as a bubble meter, dry gas meter, or mass flow meter to the top of the flow audit adapter. This reference flow meter should have been recently calibrated to a primary standard, have an accuracy of ±1% at 3 l/min and 16.67 l/min, and a pressure drop of less than 0.07 bar (1 psi).

9) Read the total flow (approximately 16.67 l/min) on the reference flow meter. If you are using a mass flow meter, you must make any necessary corrections to translate this reading to volumetric l/min at the current ambient temperature and barometric pressure. No adjustment is necessary in the case of a volumetric flow meter. The total volumetric flow measured by the reference flow meter must be 16.67 ±1.0 l/min to be acceptable.

10) Disconnect the bypass flow line from the bypass extension on the bottom of the flow splitter (Figure 5-15).

Figure 5-15. Disconnecting the bypass flow line from the bypass extension.



11) Cap the exit of the flow splitter bypass extension with the 3/8-inch Swagelok cap (Figure 5-16).

Figure 5-16. Bypass flow extension with 3/8-inch Swagelok cap.

12) Read the main flow (approximately 3.0 l/min) on the reference flow meter. If you are using a mass flow meter, you must make any necessary corrections to translate this reading to volumetric l/min at the current ambient temperature and barometric pressure. No adjustment is necessary in the case of a volumetric flow meter. The volumetric flow measured by the reference flow meter must be 3.0 ±0.2 l/min to be acceptable. If the main flow reading is within acceptable limits, go to step 14. If the main flow reading is not within acceptable limits, go to step 13.

13) Perform the software and hardware calibrations for the mass flow controller (Service Manual).

14) Remove the 3/8" Swagelok cap from the flow splitter bypass extension.

15) Install the bypass flow line onto the flow splitter bypass extension.

16) Perform a leak check (Section 3.4).

17) Remove the flow audit adapter from the top of the flow splitter.

18) Install the sample inlet onto the flow splitter.

19) Install a new TEOM filter into the mass transducer.

20) Press the <F1> or <RUN> key.

Section 6: Software Setup

This section describes the parameter settings in the software screens that affect the monitor's basic operation and sample programming. It also describes the unit's operational modes. Do not attempt the procedures described in this section until you have read Sections 2-5. Appendix A contains all of the instrument's screens, and Appendix B contains a complete list of the monitor's program register codes (PRCs).

6.1. Modes of Operation

The Series 8500 FDMS Monitor displays its current operating mode in the upper left-hand corner of the Main screen (Figure 6-1).

Figure 6-1. Main screen with operating mode field (A) highlighted.

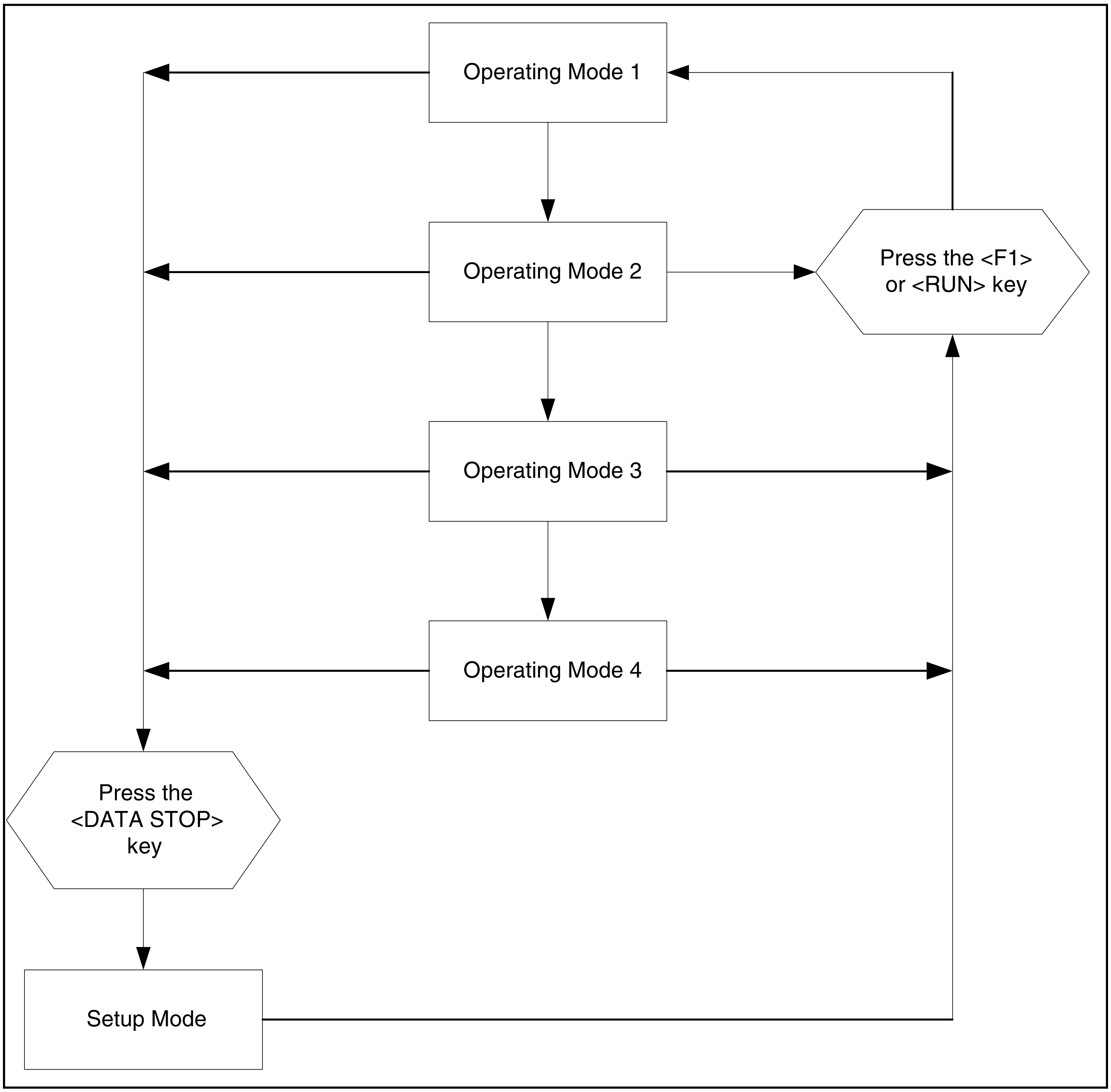
```
      A
OK    4+  21%  NU     09:39
Mass Conc              11.5
01-Hr MC               12.5
08-Hr MC                8.3
```

The unit's operating modes (Figure 6-2) are defined as follows:

Operating Mode 1 — This operating mode indicates that the unit has not begun to compute mass values, because the monitor's temperatures and flow rates are stabilizing. The temperatures and flow rates must remain within a very narrow range of values (Section 6.3) for 30 minutes before the instrument enters Operating Mode 2. The monitor always starts in Operating Mode 1 when it is turned on or reset. Press the <F1> or <RUN> key to reset the instrument from any operating mode. This action always causes the instrument to enter Operating Mode 1.

Operating Mode 2 — This operating mode indicates that the unit has begun to collect data records, but the monitor has not yet computed its first total mass value.

Figure 6-2. Overview of operating modes.



Operating Mode 3	This operating mode indicates that the unit has computed the first total mass value, but mass concentration and mass rate values are not yet available.
Operating Mode 4	This operating mode indicates that the unit is fully operational. The monitor normally resides in this mode. All mass values are being computed by the instrument.
Setup Mode	When the unit is in this operating mode, it continues to draw a sample flow and maintain operational temperatures but it does not collect any data. Certain operating parameters such as temperatures and flow rates can be changed only in this mode, because doing so during data collection (Operating Modes 1-4) would affect the data. Press <DATA STOP> to enter the Setup Mode while in any operating mode. When the unit is in the Setup Mode (S), the user can change all of the system's parameters. To leave the Setup Mode and start data collection, press either <F1> or <RUN> to return the monitor to Operating Mode 1. If the instrument remains in the Setup Mode for 5 minutes without the user pressing any key on the keypad, the monitor will automatically return to Operating Mode 1.
Stop All Mode	Certain situations may arise in which the user may want to turn off all temperatures and flows in the instrument. To initiate this procedure, press <STOP ALL> on the control unit keypad to enter the Stop All Mode. When the unit is in this operating mode, it suspends operation of the instrument. In this mode, data collection ceases, flow rates in the system drop to zero, and the output to the temperature circuits is turned off. When the instrument is in the Stop All Mode, an "X" will appear in the operating mode field of the Main screen's status line (Section 5). Also, the monitor will reset its system variables to the original values that were set by the user. However, this does not set the unit to its default parameters. The instrument will remain in the Stop All Mode until you press <F1> or <RUN> to begin data collection, or press <DATA STOP> to enter the Setup Mode, or turn off the control unit.

6.2. Set Time Screen

The user can set the system time and date when in the Set Time screen (Figure 6-3).

Figure 6-3. Set Time screen.

```
        SET TIME
16:20:03         15-Jun-04
Second  >                0
Minute                  20
```

You can display the Set Time screen on the four-line display of the control unit in three different ways:

1. Press <TIME DATE> on the control unit keypad.
2. When in the Main screen (Figure 6-1), press <STEP SCREEN> to display the Menu screen (Figure 6-4). When in the Menu screen, press the up and down arrow keys to select “Set Time,” and then press <ENTER>.
3. Press the <0> and <3> keys, and then press <ENTER>.

Figure 6-4. Menu screen.

```
  LISTING OF SCREENS
> Set Temps/Flows
  Set Hardware
  View Analog Inputs
```

The Set Time screen contains additional lines that cannot be seen when the screen first displays on the control unit’s four-line display (Figure 6-5). Press the up and down arrow keys to view the additional lines of the Set Time screen.

Figure 6-5. Set Time screen with additional lines displayed.

```
        SET TIME
16:20:03         15-Jun-04
Second  >                0
Minute                  20
--------------------------
Hour                    16
Day                     15
Month                    0
Year                  2001
```

The time and date can be changed only when the instrument is in the Setup Mode. Press <DATA STOP> on the keypad to enter the Setup Mode. The second line of the Set Time screen displays the current time and date generated by the monitor's built-in clock/calendar. To reset the system time, change any of the time variables shown on this screen.

NOTE: Every time you make a new entry, the instrument resets the "second" counter to "00."

The Set Time screen contains the following information:

16:20:03	This field contains the current time (hh:mm:ss).
15-Jun-02	This field contains the current date (dd-mmm-yy).
Second	This field contains the second (ss) parameter of the clock.
Minute	This field contains the minute (mm) parameter of the clock.
Hour	This field contains the hour (hh) parameter of the clock.
Day	This field contains the day of the month (dd) parameter of the date.
Month	This field contains the numerical month (mm) parameter of the date. January is month "0" and December is month "11." When editing the month, it is simpler to use the up and down arrow keys, instead of entering the number of the month on the control unit keypad.
Year	This field contains the year (yyyy) parameter of the date.

6.3. Set Temps/Flows Screen

The user can view and set the temperatures and flow rates when in the Set Temps/ Flows screen (Figure 6-6).

Figure 6-6. Set Temps/ Flows screen.

```
      SET TEMPS/FLOWS
T-Case>    30.00    30.00
T-Air      30.00    30.00
T-Cap      30.00    29.98
```

You can display the Set Temps/Flows screen on the four-line display of the control unit in three different ways:

1. When in the Main screen (Figure 6-1), press <STEP SCREEN> on the control unit keypad to display the Menu screen (Figure 6-4). When in the Menu screen, press the up and down arrow keys to select "Set Temps/ Flows," and then press <ENTER>.
2. When in the Set Hardware screen (Section 6.4), press <STEP SCREEN>.
3. Press the <1> and <9> keys, and then press <ENTER>.

Each temperature and flow rate has two numbers associated with it. The left-hand value is the parameter setting, and can be changed. The right-hand number is the current value, and cannot be changed.

The Set Temps/Flows screen contains additional lines that cannot be seen when the screen first displays on the control unit's four-line display (Figure 6-7). Press the up and down arrow keys to view the additional lines of the Set Temps/Flows screen.

Figure 6-7. Set Temps/Flows screen with additional lines displayed.

SET TEMPS/FLOWS		
T-Case>	30.00	30.00
T-Air	30.00	30.00
T-Cap	30.00	29.98
F-Main	3.00	3.00
F-Aux	13.67	13.65
T-A/S	25.00	25.00
P-A/S	1.000	1.000
Amb Temp		23.4
Amb Pres		0.988
FAdj Main		1.000
FAdj Aux		1.000

The Set Temps/Flows screen contains the following information:

T-Case — This field contains the setting and current value of the temperature (°C) inside the control unit. The default setting is 30° C and can be adjusted when the monitor is in the Setup Mode. The current value cannot be edited.

T-Air — This field contains the setting and current value of the temperature (°C) of the air stream as it enters the mass transducer. The default setting is 30° C and can be adjusted when the monitor in the Setup Mode. The current value cannot be edited.

T-Cap — This field contains the setting and current value of the temperature (°C) inside the mass transducer. The default setting is 30° C and can be adjusted when the monitor is in the Setup Mode. The current value cannot be edited.

F-Main — This field contains the setting and current value of the main (SENSOR FLOW) flow rate (l/min). The default setting is 3 l/min and can be adjusted when the monitor is in the Setup Mode. The current value cannot be edited.

F-Aux	This field contains the setting and current value of the auxiliary (BYPASS FLOW) flow rate (l/min). The default setting is 13.67 l/min and can be adjusted when the monitor is in the Setup Mode. The current value cannot be edited.
T-A/S	This field contains the average and standard temperature (°C) settings. The default setting for both parameters is 25° C and can be adjusted when the monitor is in the Setup Mode. The user can use these values to set the unit's volumetric flow control (Sections 6.3.1 and 6.3.2) and to determine how the unit reports the mass concentration levels (Sections 6.3.3 and 6.3.4). If the instrument has been used before and the user wants to return it to its original settings, the user should first re-initialize the unit (Section 13) before setting the unit's reporting standards.
P-A/S	This field contains the average and standard atmospheric pressure (atm) settings. The default setting for both parameters is 1 atm and can be adjusted when the monitor is in the Setup Mode. The user can use these values to set the unit's volumetric flow control (Sections 6.3.1 and 6.3.2) and to determine how the unit reports the mass concentration levels (Sections 6.3.3 and 6.3.4). If the instrument has been used before and the user wants to return it to its original settings, the user should first re-initialize the unit (Section 13) before setting the unit's reporting standards.
Amb Temp	This field contains the current ambient temperature (°C) at the site. This value cannot be edited and will be correct only when the ambient temperature sensor is properly installed (Section 2).
Amb Pres	This field contains the current ambient pressure (atm) at the site. This value cannot be edited.
FAdj Main	This field contains the main flow adjustment factor. This value is used during the software calibration of the mass flow controller (Service Manual). The

	default setting for this parameter is "1.000" and this value can be adjusted when the monitor is in the Setup Mode.
FAdj Aux	This field contains the auxiliary flow adjustment factor. This value is used during the software calibration of the mass flow controller (Service Manual). The default setting for this parameter is "1.000" and this value can be adjusted when the monitor is in the Setup Mode.

The Series 8500 FDMS Monitor uses mass flow controllers to ensure a constant and precise flow through the instrument. The mass flow controllers use the actual (active volumetric flow control setting) or average (passive volumetric flow control setting) temperature and pressure values to regulate the volumetric flow through the system. The active volumetric flow control setting (Section 6.3.1) directs the unit to use the actual ambient temperature and pressure to regulate the volumetric flow through the system. The passive volumentric flow control setting (Section 6.3.2) directs the unit to use the average temperature and pressure values to regulate the volumetric flow through the system. The instrument is delivered with the following temperatures and pressures settings:

Standard temperature .... 25°C	Standard pressure .. 1 atmosphere (atm)
Average temperature .... 25°C	Average pressure .. 1 atmosphere (atm)

If the user receives the FDMS Series 8500 module directly from Thermo, the only change that the user must make, before using the instrument for U.S. EPA-equivalent PM-10 measurements, is to choose how they want the monitor to control the volumetric flow: actively (Section 6.3.1) or passively (Section 6.3.2). If the user wants to use the instrument for US EPA-equivalent PM-10 measurements, they must ensure that the standard temperature is set to 25°C, and the standard pressure is set to 1 atm, regardless of the values that they entered for the average temperature and average pressure settings. Also, if the monitor has been used before and the user wants to return it to its original settings, the user should first re-initialize the unit (Section 13) before selecting the active or passive volumetric flow control setting.

The unit also uses the parameters in the Set Temps/Flows screen to determine how to report the measured mass concentration levels. The user can choose to report the mass concentration levels to actual (Section 6.3.3) or standard conditions (Section 6.3.4).

If the user chooses to set the unit to report the mass concentration levels to actual conditions, they must they should set the average and standard temperatures to "99," and the average and standard pressures to "9" when in the Set Temps/Flows screen

(Figure 6-6). This will cause the monitor to use the actual ambient temperature and ambient pressure in its flow rate calculations.

If the user chooses to set the unit to report the mass concentration levels to standard conditions, they must set the standard temperatures and pressures to the appropriate standard regulatory values when in the Set Temps/Flows screen (Figure 6-6). This will cause the monitor to use the standard temperature and pressure values in its sample volume calculations (Section 1).

> NOTE: If the user wants to use the instrument for US EPA-equivalent PM-10 measurements, they must ensure that the standard temperature is set to 25°C, and the standard pressure is set to 1 atm (Section 6.3.4), regardless of the values that they entered for the average temperature and average pressure settings.

6.3.1. Active Volumetric Flow Control

The Series 8500 FDMS Monitor uses mass flow controllers to ensure a constant and precise volumetric flow through the instrument. The mass flow controllers use the actual (active volumetric flow control setting) or average (passive volumetric flow control setting) temperature and pressure values to regulate the volumetric flow through the system. The active volumetric flow control setting directs the unit to use the actual ambient temperature and pressure to regulate the volumetric flow through the system. The passive volumentric flow control setting directs the unit to use the average temperature and pressure values to regulate the volumetric flow through the system. If the user wants the unit to use the actual temperature and pressure to control the volumetric flow, they should set the average temperature to “99,” and the average pressure to “9” when in the Set Temps/Flows screen (Figure 6-6).

> NOTE: If the user wants to use the instrument for U.S. EPA-equivalent PM-10 measurements, they must ensure that the standard temperature is set to 25°C, and the standard pressure is set to 1 atm (Section 6.3.4), regardless of the values that they entered for the average temperature and average pressure settings.

If the user chooses to use the actual temperature and pressure to control the volumetric flow, they must install the ambient temperature sensor (Section 2). The instrument’s mass flow controllers measure flow on a mass basis. All of the size-selective inlets (Section 2), including the PM-10 inlet, operate on a constant volumetric flow basis. To measure accurate mass concentration levels when using a size-selective inlet, the user must make a density adjustment to the mass flow controllers using the temperature and pressure values.

Follow these steps to use the actual temperature and pressure values to control the volumetric flow:

IMPORTANT: Ensure that the ambient temperature sensor is installed on the monitor (Section 2).

1) **Press <DATA STOP>.**
2) **When in the Main screen (Figure 6-1), press <STEP SCREEN> to display the Menu screen (Figure 6-4).**
3) **When in the Menu screen, press the up and down arrow keys to select “Set Temps/Flows,” and then press <ENTER> to display the Set Temps/Flows screen (Figure 6-6). You also can press the <1> and <9> keys, and then press <ENTER> to display the Set Temps/Flows screen.**

4) Press the <EDIT> key.

5) When in the Set Temps/Flows screen, press the arrow keys to select the left-hand column in the "T-A/S" line.

6) Use the monitor's keypad to enter "99" as the average temperature.

7) Press the arrow keys to select the left-hand column in the "P-A/S" line.

8) Use the monitor's keypad to enter "9" as the average pressure at the site.

9) Press <ENTER>.

10) Press <F1> or <RUN> to restart data collection.

6.3.2. Passive Volumetric Flow Control

The Series 8500 FDMS Monitor uses mass flow controllers to ensure a constant and precise flow through the instrument. The mass flow controllers use the actual (active volumetric flow control setting) or average (passive volumetric flow control setting) temperature and pressure values to regulate the volumetric flow through the system. The active volumetric flow control setting directs the unit to use the actual ambient temperature and pressure to regulate the volumetric flow through the system. The passive volumentric flow control setting directs the unit to use the average temperature and pressure values to regulate the volumetric flow through the system.

The average temperature and average pressure (used by the instrument) may vary with season and altitude. If the user wants the unit to use the average temperature and pressure to control the volumetric flow, they should manually adjust the average temperature and average pressure settings as climatic conditions change. The user usually has to adjust the average pressure only once for the average barometric pressure at the sampling site (i.e., station pressure - not adjusted to sea level). However, the user generally must adjust the average temperature periodically (often 4 times per year) in accordance with changing average ambient temperatures.

> **IMPORTANT:** If you have installed the ambient temperature sensor on the monitor, you must enter “99” in the average temperature field and “9” in the average pressure field.

If the user installs the instrument at an altitude that is different from sea level, the user must set the average pressure to a value other than 1 atm, so that the instrument can maintain its proper volumetric flow within acceptable limits. When the user enters an average pressure of less than 1 atm, it reduces the instrument’s mass flow rate, but ultimately maintains the appropriate volumetric flow for the altitude.

Similarly, average daily temperatures may not always be 25° C. In such cases, the user must adjust the average temperature seasonally to account for changes in mean temperatures. If the user enters an average temperature of less than 25° C in the system, the mass flow through the sampling head increases so that the proper volumetric flow remains within acceptable limits.

> NOTE: If the user wants to use the instrument for U.S. EPA-equivalent PM-10 measurements, they must ensure that the standard temperature is set to 25°C, and the standard pressure is set to 1 atm (Section 6.3.4), regardless of the values that they entered for the average temperature and average pressure settings.

The instrument's mass flow controllers measure flow on a mass basis. All of the size-selective inlets (Section 2), including the PM-10 inlet, operate on a volumetric flow basis. To measure accurate mass concentration levels when using a size-selective inlet, the user must make a density adjustment to the mass flow controllers using the temperature and pressure values.

Follow these steps to use the average temperature and pressure values to control the volumetric flow:

1) **Press <DATA STOP>.**
2) **When in the Main screen (Figure 6-1), press <STEP SCREEN> to display the Menu screen (Figure 6-4).**
3) **When in the Menu screen, press the up and down arrow keys to select "Set Temps/Flows," and then press <ENTER> to display the Set Temps/Flows screen (Figure 6-6). You also can press the <1> and <9> keys, and then press <ENTER> to display the Set Temps/Flows screen.**
4) **Press <EDIT>.**
5) **When in the Set Temps/Flows screen, press the arrow keys to select the left-hand column in the "T-A/S" line.**
6) **Use the keypad to enter the average temperature at the site. For example, press <2> and <0> to change the average temperature to 20°C.**
7) **Press the arrow keys to select the left-hand column in the "P-A/S" line.**
8) **Use the keypad to enter the average pressure at the site. For example, press <0>, <.>, <9> and <3> to change the average pressure to 0.93 atm.**
9) **Press <ENTER>.**
10) **Press <F1> or <RUN> to restart data collection.**

6.3.3. Reporting to Actual Conditions

The unit uses the parameters in the Set Temps/Flows screen to determine how to report the measured mass concentration levels. If the user chooses to set the unit to report the mass concentration levels to actual conditions, they must set the average and standard temperatures to “99,” and the average and standard pressures to “9” when in the Set Temps/Flows screen (Figure 6-6). This will cause the monitor to use the actual ambient temperature and ambient pressure in its flow rate calculations.

NOTE: If the user wants to use the instrument for U.S. EPA-equivalent PM-10 measurements, they must ensure that the standard temperature is set to 25°C, and the standard pressure is set to 1 atm (Section 6.3.4), regardless of the values that they entered for the average temperature and average pressure settings.

IMPORTANT: You MUST install the ambient temperature sensor on your FDMS Series 8500 Monitor to set your unit to report the mass concentration levels to actual conditions.

Follow these steps to set the monitor to use the actual temperature and pressure values in flow rate calculations:

IMPORTANT: Ensure that the ambient temperature sensor is installed on the monitor (Section 2).

1) Press <DATA STOP>.

2) When in the Main screen (Figure 6-1), press <STEP SCREEN> to display the Menu screen (Figure 6-4).

3) When in the Menu screen, press the up and down arrow keys to select “Set Temps/Flows,” and then press <ENTER> to display the Set Temps/Flows screen (Figure 6-6). You also can press <1> and <9>, and then press <ENTER> to display the Set Temps/Flows screen.

4) Press <EDIT>.

5) When in the Set Temps/Flows screen, press the arrow keys to select the left-hand column in the “T-A/S” line.

6) Use the keypad to enter “99” as the average temperature.

7) Press the right arrow key to select the right-hand column in the “T-A/S” line.

8) **Use the keypad to enter "99" as the standard temperature.**
9) **Press the arrow keys to select the left-hand column in the "P-A/S" line.**
10) **Use the keypad to enter "9" as the average pressure at the site.**
11) **Press the right arrow key to select the right-hand column in the "P-A/S" line.**
12) **Use the keypad to enter "9" as the standard pressure.**
13) **Press <ENTER>.**
14) **Press <F1> or <RUN> to restart data collection.**

6.3.4. Reporting to Standard Conditions

The unit uses the parameters in the Set Temps/Flows screen to determine how to report the measured mass concentration levels. If the user chooses to set the unit to report the mass concentration levels to standard conditions, they must set the standard temperatures and pressures to the appropriate standard regulatory values when in the Set Temps/Flows screen (Figure 6-6). This will cause the monitor to use the standard temperature and pressure values in its flow rate calculations.

NOTE: If the user wants to use the instrument for US EPA-equivalent PM-10 measurements, they must ensure that the standard temperature is set to 25°C, and the standard pressure is set to 1 atm, regardless of the values that they entered for the average temperature and average pressure settings.

IMPORTANT: If your standard regulatory settings are different from the US EPA-equivalent PM-10 measurements, be sure to set the standard temperature and pressure settings as required.

Follow these steps to use the standard temperature and pressure values in flow rate calculations:

1) **Press <DATA STOP>.**
2) **In the Main screen (Figure 6-1), press <STEP SCREEN> to display the Menu screen (Figure 6-4).**
3) **In the Menu screen, press the up and down arrow keys to select “Set Temps/Flows,” and then press <ENTER> to display the Set Temps/Flows screen (Figure 6-6). You also can press <1> and <9>, and then press <ENTER> to display the Set Temps/Flows screen.**
4) **Press <EDIT>.**
5) **In the Set Temps/Flows screen, set the unit’s volumetric flow control setting (Section 6.3.1 or Section 6.3.2).**
6) **Press the arrow keys to select the right-hand column in the “T-A/S” field.**

7) Enter the standard temperature value in this field. If you are setting the unit to report to the US EPA-equivalent PM-10 measurements, press <2> and <5> ("25") on the keypad. This sets the standard temperature to "25," which causes the monitor to use the standard temperature in flow rate calculations.

8) Press the arrow keys to select the right-hand column in the "P-A/S" field.

9) Enter the standard pressure value in this field. If you are setting the unit to report to the US EPA-equivalent PM-10 measurements, press <1> on the keypad. This sets the standard pressure to "1," which causes the monitor to use the standard pressure in flow rate calculations.

10) Press <ENTER>.

11) Press <F1> or <RUN> to restart data collection.

6.4. Set Hardware Screen

The Set Hardware screen (Figure 6-8) allows the user to view and change selected hardware parameters.

Figure 6-8. Set Hardware screen.

```
       SET HARDWARE
Cal Const>           9605
Ser Num             22822
Wait Time            1800
```

You can display the Set Hardware screen on the four-line display of the control unit in three different ways:

1. When in the Main screen (Figure 6-1), press <STEP SCREEN> on the control unit keypad to display the Menu screen (Figure 6-4). When in the Menu screen, press the up and down arrow keys to select "Set Hardware," and then press <ENTER>.
2. When in the Set Temps/Flows screen (Section 6.3), press the <STEP SCREEN> key.
3. Press the <1> and <3> keys, and then press the <ENTER> key.

The Set Hardware screen contains additional lines that cannot be seen when the screen first displays on the control unit's four-line display (Figure 6-9). Press the up and down arrow keys to view the additional lines of the Set Hardware screen.

Figure 6-9. Set Hardware screen with additional lines displayed.

```
       SET HARDWARE
Cal Const>           9605
Ser Num             22822
Wait Time            1800
-------------------------
Gate Time               5
XX-Hr MC                8
Soft Rate        0.000000
Hard Rate        0.000000
Version             3.016
Mass Avg              360
```

The Set Hardware screen contains the following information:

Cal Const	This field contains the calibration constant, K_o (K0) (Section 1). You can find your monitor's K_o on the label located inside the mass transducer, which is located inside the sensor unit. Each monitor has a unique K_o. The "Cal Const" value must match the value shown on the label inside the mass transducer, or the mass concentration data will be incorrect. This parameter can be edited when the monitor is in the Setup Mode.
Ser Num	This field contains the monitor's serial number. You can find your monitor's serial number on the back panel of the sensor and control units. The "Ser Num" value must match the number found on the hardware. This parameter can be edited when the monitor is in any operating mode.
Wait Time	This field contains the length of time (sec) in which the temperatures and flow rates must remain (within a range around their setpoints) before the instrument changes from Operating Mode 1 to 2. The default setting is "1800" seconds. This parameter can be edited when the monitor is in any operating mode.

NOTE: R&P recommends that the user set the "Wait Time" to "1000" or higher to avoid damaging the instrument, and to maintain accurate data reporting.

Gate Time	The basis of mass change is raw frequency. Raw frequency is calculated by comparing cycle counts of a highly stable 10 megahertz (Mhz) clock to the cycle counts of the oscillating tapered element (TE). The gate time controls how often the comparisons are made. This parameter cannot be edited.
XX-Hr MC	This field contains the XX-Hr MC parameter. This value gives the user a choice of averaging times (hours) shown on the Main screen, following the 1-hour mass concentration average. The default value for this parameter is "8," which causes the monitor to compute 8-hour averages. The user can set an

averaging time of 1, 8, 12, or 24 hours for this parameter. This parameter can be edited when the monitor is in the Setup or Stop All Mode.

Soft Rate	The monitor makes "Soft Rate" software and hardware adjustments for internal clock drift correction. This value is set before the instrument leaves R&P and should not be changed, unless the user loads new software into the instrument. If the user loads new software into the instrument, the Soft Rate value will return to its default setting ("0"). The user must then follow the procedure for setting the internal clock (Service Manual) to set the Soft Rate to its appropriate value.
Hard Rate	The monitor makes "Hard Rate" software and hardware adjustments for internal clock drift correction. This value is set before the instrument leaves R&P and should not be changed, unless the user loads new software into the instrument. If the user loads new software into the instrument, the Hard Rate value will return to its default setting ("0"). The user must then follow the procedure for setting the internal clock (Service Manual) to set the Hard Rate to its appropriate value.
Version	This field contains the monitor's software revision number. This parameter can not be edited.
Mass Ave	This field contains the time interval (sec) at which the monitor switches the flow between the main flow and the bypass flow (Section 1). This parameter cannot be edited.

6.5. Set Storage Screen

The Set Storage screen (Figure 6-10) determines which variables are stored in the monitor's internal data logger, how many data fields exist per record, and the interval at which records are stored. The capacity of the data logger, as measured by the number of records, depends upon the number of data fields (system variables) stored in each record. The instrument always stores the time, date and station number in each record in addition to any data fields selected by the user.

Figure 6-10. Set Storage screen.

```
      SET STORAGE
Stor Var1      > 01-Hr MC
Stor Var2        24-Hr MC
Stor Var3        Samp Dew
```

Figure 6-11 shows the capacity of the monitor's internal storage. Because header information is stored in each record, the capacity of the data logger does not decrease proportionately with an increase in the number of data fields per record.

Figure 6-11. Approximate internal data storage capacity for the Series 8500 FDMS Monitor.

Internal Data Storage Capacity*

Data Fields per Record	Capacity in Records	Capacity in Time**
1	7,017	20.8 weeks
2	4,911	14.6 weeks
3	3,777	11.2 weeks
4	3,069	9.1 weeks
5	2,584	7.6 weeks
6	2,231	6.6 weeks
7	1,964	5.8 weeks
8	1,753	5.2 weeks

* Minumum storage capacity. Most configurations store more data.
** Computed using a storage interval of 30 minutes.

You can display the Set Storage screen on the four-line display of the control unit in two different ways:

1. When in the View Storage screen (Section 8), press the <STEP SCREEN> key on the control unit's keypad.
2. Press the <0> and <9> keys, and then press the <ENTER> key.

The Set Storage screen contains additional lines that cannot be seen when the screen first displays on the control unit's four-line display (Figure 6-12). Press the up (<↑>) and down (<↓>) arrow keys to view the additional lines of the Set Storage screen.

Figure 6-12. Set Storage screen with additional lines displayed.

```
       SET STORAGE
Stor Var1      > 01-Hr MC
Stor Var2        24-Hr MC
Stor Var3        Samp Dew
-------------------------
Stor Var4       Frequency
Stor Var5        Tot Mass
Stor Var6        Amb Temp
Stor Var7            Null
Stor Var8            Null
Interval            60.00
Stor Vars               4
Station          48048048
```

The Set Storage screen contains the following information:

Stor Var 1-8	These fields contain the names of the variables that are currently being stored in the internal data logger. The monitor will store a maximum of eight variables in a record. These parameters can be edited when the monitor is in any operating mode.
Interval	This field contains the time (sec) interval between successive writings of data to the circular buffer. For example, if the user sets this field to "3600," the monitor will record data to the internal data logger every hour. The averaging time of the analog input is equal to the data storage interval. The default setting

for this value is 1,800 seconds. This parameter can be edited when the monitor is in any operating mode.

✘ Changing the value for "Stor Vars" erases the storage buffer.

Stor Vars — This field contains the number of data fields that the monitor will store per record. The default setting for this parameter is 8 variables. This parameter can be edited when the monitor is in any operating mode.

IMPORTANT: All data stored in the internal data logger are lost when you change the value of the "Stor Vars" parameter.

Station — This field contains the station location variable. This parameter contains an ASCII string (which is a representation of a numeric field) (Appendix I) that can be up to three-digits long. The ASCII string is stored with every record in the internal data logger, and is transmitted every time data are sent to a serial device. The default setting for this parameter is "48048048," which is the ASCII code for "000." This parameter can be edited when the monitor is in any operating mode.

Follow these steps to change the Stor Var(1-8) variables:

1) Press the <DATA STOP> key.

2) When in the Main screen (Figure 6-1), press the <STORE> key to display the View Storage screen (Section 8).

3) When in the View Storage screen, press the <STEP SCREEN> key to display the Set Storage screen (Figure 6-9). You also can press the <0> and <9> keys, and then press the <ENTER> key to display the Set Storage screen.

4) Press the <EDIT> key. The ">" cursor will now change to the "?" cursor.

5) When in the Set Storage screen, press the up (<↑>) and down (<↓>) arrow keys to select the Stor Var(1-8) fields that you want to edit. You can change the variable in each Stor Var field in one of two ways:

1. Enter the number of the appropriate program register code (PRC) (Appendix B) using the control unit's keypad.

2. Press the up (<↑>) and down (<↓>) arrow keys to increase or decrease the

PRC number. To increase the PRC number by one, press the up (<↑>) arrow key. For example, if the mass concentration (PRC 008) is displayed in Stor Var1, and the user wants to change the PRC to total mass (PRC 009), the user would press the up (<↑>) arrow key. To decrease the PRC number by one, press the down (<↓>) arrow key. To increase the PRC number by 10 steps at a time, press the <SHIFT> key and hold it down while pressing the up (<↑>) arrow key. To decrease the PRC number by 10 steps at a time, press the <SHIFT> key and hold it down while pressing the down (<↓>) arrow key. To increase the PRC number by 20 steps at a time, press the <CTRL> key and hold it down while pressing the up (<↑>) arrow key. To decrease the PRC number by 20 steps at a time, press the <CTRL> key and hold it down while pressing the down (<↓>) arrow key.

6) **Press the up (<↑>) and down (<↓>) arrow keys to select the “Interval” field.**

7) **Enter the time interval using the control unit’s keypad.**

✘ Changing the value for “Stor Vars” erases the storage buffer.

8) **Press the up (<↑>) and down (<↓>) arrow keys to select the “Stor Vars” field.**

   IMPORTANT: All data presently stored in the internal data logger will be lost when you change the value of the “Stor Vars” parameter.

9) **Enter the number of storage variables (Stor Var(1-8)) that you want the monitor to store. For example, if you set Stor Var1 to record mass concentration (PRC 008), Stor Var2 to record the 1-hour mass concentration measurement (PRC 57), Stor Var3 to record total mass (PRC 009), and Stor Var4 to record the volatility coefficient (PRC 011), you would set the “Stor Vars” field to “4.”**

10) **Press the up (<↑>) and down (<↓>) arrow keys to select the “Station” field.**

11) **Enter the station number using the control unit’s keypad.**

12) **Press the <ENTER> key. The “?” cursor will now change to the “>” cursor.**

13) **Press the <F1> or <RUN> key to restart data collection.**

To erase the contents of the circular storage buffer (internal data logger), change the value of the “Stor Vars” variable. For example, if the “Stor Vars” variable has a value of “8,” change the value to “0” and then back to “8,” to clear the buffer and resume storing eight data fields per record.

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Section 7: Status Codes

This section describes the status codes generated by the Series 8500 FDMS Monitor, and the operating information contained in the Mass Concentration screen.

7.1. Status Codes

The current status condition (Figure 7-1) is located on the upper left-hand corner of the Main screen. It is an alphanumeric code that indicates the operational status of the instrument, indicating any status condition that exists.

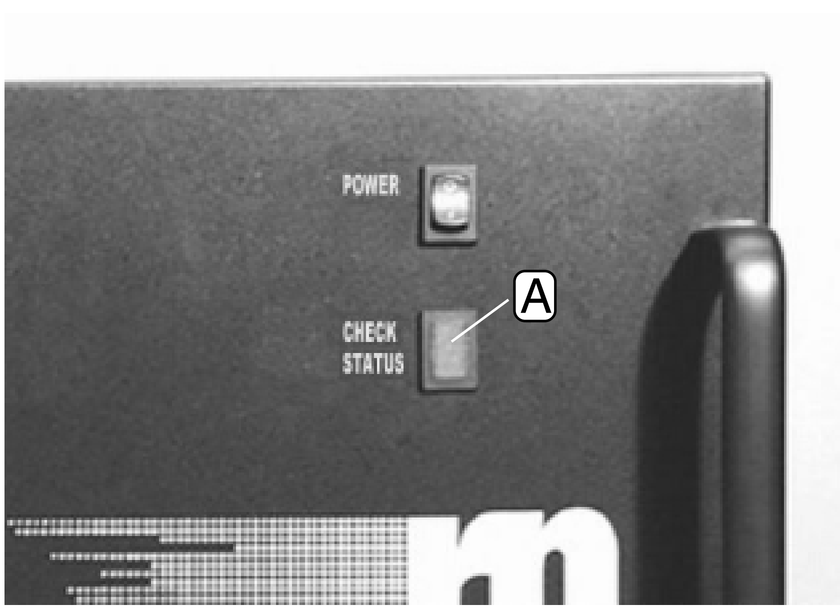
Figure 7-1. Main screen with the current status condition (A) highlighted.

  A

```
OK     4+   21%   NU      09:39
Mass Conc                  11.5
01-Hr MC                   12.5
08-Hr MC                    8.3
```

Whenever a status code (other than "OK") is displayed on the Main screen, the instrument automatically turns on the "CHECK STATUS" light (Figure 7-2) on the front panel of the control unit.

Figure 7-2. Control unit with the "CHECK STATUS" light (A) highlighted.



The status condition can consist of one or more of the following codes:

OK	Normal operation. No current status conditions.
M	Frequency signal failure. Control unit is not receiving a frequency signal.
T	Temperature(s) outside of operational bounds. The range is ± 0.5°C for all temperatures.
F	Flow(s) outside of operational bounds. The range is ± 0.1 l/min for the main flow and ± 0.4 l/min for the auxilliary (bypass) flow.
X	Exchange filter. This status code becomes active when the filter loading percentage reaches 90% capacity.
V	Voltage low. This status code becomes active when the AC voltage reading drops below 105 volts.
C	Cooler status. This status code becomes active when the temperature varies ± 1°C from the setpoint of 4°C.
P	Valve position. This status code becomes active when the valve directing the flow is not positioned properly.
D	Drier status. This status code becomes active when the dew point measured downstream of the 8500 module exceeds 2°C.
I	Inlet humidity high. This status code becomes active when the relative humidity at the drier inlet exceeds 98%.

NOTE: A frequency signal failure (“M”) status condition automatically triggers the temperature outside of operational bounds (“T”) status code, because the monitor turns off the air and case temperature controls when the mass transducer does not output a frequency.

In the Main screen, press <MAIN/STATUS> on the keypad to display the Status Codes screen (Figure 7-3). The Status Codes screen provides an explanation of the current status conditions.

Figure 7-3. Status Codes screen.

```
 CURRENT STATUS CODES
>M        Mass Transducer
 T            Temperature
 F             Flow Rates
```

The Status Codes screen contains more information lines than can be viewed at one time. Press the down arrow key on the control unit keypad to view additional information lines (Figure 7-4).

Figure 7-4. Status Codes screen with status conditions and additional lines displayed.

```
 CURRENT STATUS CODES
>M        Mass Transducer
 T            Temperature
 F             Flow Rates
---------------------------
 X        Exchange Filter
 V            Voltage Low
 C          Cooler Status
 P         Valve Position
 D           Drier Status
 I          Inlet RH High
```

If the instrument status condition is “OK,” the Status Codes screen will display “No Curr Conditions” (Figure 7-5).

Figure 7-5. Status Codes screen with “OK” status code displayed.

```
 CURRENT STATUS CODES
>No Curr Conditions
```

7.2. Mass Concentration Screen

Based upon the adjusted change in the filter sample mass and sampled volume, the Series 8500 FDMS Monitor computes a one-hour running average of the particulate matter (PM) mass concentration and displays this value in the Mass Concentration screen (Figure 7-6). The instrument updates this value every six minutes based on the newest information (Section 1). The unit calculates the mass concentration (MC) based on the slope of the frequency (mass) that is measured during each base/reference time period (six minutes).

> NOTE: Upon initial instrument start up, the values in the mass concentration fields are the running averages that are accumulated until a 1-hour time period has passed. The values are visible to provide the user with an indication that the instrument is functioning, after instrument power up or reset. These raw values are used for internal calculations only.

Figure 7-6. Mass Concentration screen.

```
 Mass Concentration
Curr Chan            BASE
Mass Conc            11.5
Base MC              10.3
```

You can display the Mass Concentration screen on the four-line display of the control unit in two different ways:

1. When in the Main screen (Figure 7-1), press <STEP SCREEN> to display the Menu screen (Figure 7-7). When in the Menu screen, press the up and down arrow keys to select “Mass Concentration,” and then press <ENTER>.
2. Press <1> and <4>, and then press <ENTER>.

Figure 7-7. Menu screen.

```
 LISTING OF SCREENS
>Set Temps/Flows
 Set Hardware
 View Analog Inputs
```

Figure 7-8. Mass Concentration screen with additional lines displayed.

```
 Mass Concentration
Curr Chan           BASE
Mass Conc           11.5
Base MC             10.3
Ref MC              -1.2
```

The Mass Concentration screen contains more information lines than can be viewed simultaneously. Press the down arrow key on the control unit keypad to view the additional information lines (Figure 7-8).

The Mass Concentration screen contains the following information:

Curr Chan	This field contains the current air channel that the monitor is drawing air through. The air channels are defined as “BASE” for the base flow, and “REF” for the reference flow (Section 1).
Mass Conc	This field contains the mass concentration value. The unit calculates the mass concentration (MC) value by subtracting the Ref MC from the Base MC.
Base MC	This field contains the mass concentration value recorded by the TEOM filter while the FDMS system draws dried ambient air (base flow) through the sample flow lines (Section 1).
Ref MC	This field contains the mass concentration value recorded by the TEOM filter while the FDMS system draws dried, filtered and cooled ambient air (reference flow) through the sample flow lines (Section 1).

For example, the unit draws a base flow for six minutes and measures a mass concentration of “5” (Base MC = 5). Then the unit draws a reference flow for six minutes and measures a mass concentration of “-1” (Ref MC = -1).

Therefore, the mass concentration is “6,” where:

MC = Base MC - Ref MC

6 = 5 - (-1)

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Section 8: Viewing Stored Data

The Series 8500 FDMS Monitor contains a battery-backed circular buffer (internal data logger) for the storage of historical instrument results (data records). This section describes how to view data records currently stored in the monitor's internal data logger (circular storage buffer). The capacity of the data logger, as measured by the number of records, depends on the number of data fields (system variables) stored in each record. The instrument always stores the time, date and station number in each record, and eight other system variables can be defined by the user in the Set Storage screen (Section 6).

Figure 8-1 displays the capacity of the monitor's internal data storage. Because header information is stored in each record, the capacity of the data logger does not decrease proportionately with an increase in the number of data fields per record. Data records can be viewed on the screen of the monitor (Section 8.1) and/or downloaded through the RS232 port (Section 8). When this buffer is filled, the oldest data points are replaced with the most recent information ("first in, first out").

Figure 8-1. Approximate internal data storage capacity.

Internal Data Storage Capacity*		
Data Fields per Record	**Capacity in Records**	**Capacity in Time****
1	7,017	20.8 weeks
2	4,911	14.6 weeks
3	3,777	11.2 weeks
4	3,069	9.1 weeks
5	2,584	7.6 weeks
6	2,231	6.6 weeks
7	1,964	5.8 weeks
8	1,753	5.2 weeks

* Minumum storage capacity. Most configurations store more data.
** Computed using a storage interval of 30 minutes.

8.1. VIEW STORAGE SCREEN

The View Storage screen (Figure 8-2) allows users to view the data records stored in the monitor's internal data logger (circular storage buffer). The fields in this screen cannot be edited.

Figure 8-2. View Storage screen.

```
VIEW STORAGE            2056
16:20:03           15-Jun-04
>01-Hr MC               34.9
 24-Hr MC               12.3
```

You can display the View Storage screen on the four-line display of the control unit in three different ways:

1. Press <STORE> on the control unit keypad.
2. In the Main screen (Figure 8-3), press <STEP SCREEN> to display the Menu screen (Figure 8-4). In the Menu screen, press the up and down arrow keys to select "View Storage," and then press <ENTER>.
3. Press <0> and <8>, and then press <ENTER>.

Figure 8-3. Main screen.

```
OK    4+  21%  NU     09:39
Mass Conc              11.5
01-Hr MC               12.5
08-Hr MC                8.3
```

Figure 8-4. Menu screen.

```
  LISTING OF SCREENS
> Set Temps/Flows
  Set Hardware
  View Analog Inputs
```

The View Storage screen contains additional lines that cannot be seen when the screen first displays on the control unit's four-line display (Figure 8-5). Press the up and down arrow keys to move the ">" cursor on the screen up or down one line at a time. To move the cursor up six lines, press the <SHIFT> key and hold it down while pressing the up (<↑>) arrow key. To move the cursor down six lines, press the <SHIFT> key and hold it down while pressing the down (<↓>) arrow key. To move the cursor to the first line of the screen, press the <CTRL> key and hold it down while pressing the up (<↑>) arrow key. To move the cursor to the last line of the screen, press the <CTRL> key and hold it down while pressing the down (<↓>) arrow key.

Figure 8-5. View Storage screen with additional lines displayed.

```
VIEW STORAGE            2056
16:20:03           15-Jun-04
> 01-Hr MC              34.9
  24-Hr MC              12.3
----------------------------
  Main Flow              3.0
  Frequency         248.3217
      Noise            5.438
       Null                0
       Null                0
       Null                0
```

The View Storage screen contains the following information:

2056	This field contains the record number of the current physical data record displayed. The instrument uses a circular storage buffer, which means that when the monitor reaches the end of the data storage buffer (fills up its internal data logger with data records), it replaces the very first physical data record that was stored with a new data record.
16:20:03	This field contains the beginning sample time (hh:mm:ss) of the current data record displayed.
15-Jun-02	This field contains the date (dd-mmm-yy) of the current data record displayed.

01-Hr MC	This field contains the value of a user-defined storage variable that was stored in the internal data logger. If this field displays "Null" this means that the user did not define a variable to be stored in this field.
24-Hr MC	This field contains the value of a user-defined storage variable that was stored in the internal data logger. If this field displays "Null" this means that the user did not define a variable to be stored in this field.
Main Flow	This field contains the value of a user-defined storage variable that was stored in the internal data logger. If this field displays "Null" this means that the user did not define a variable to be stored in this field.
Frequency	This field contains the value of a user-defined storage variable that was stored in the internal data logger. If this field displays "Null" this means that the user did not define a variable to be stored in this field.
Noise	This field contains the value of a user-defined storage variable that was stored in the internal data logger. If this field displays "Null" this means that the user did not define a variable to be stored in this field.
Null	This field contains the value of a user-defined storage variable that was stored in the internal data logger. If this field displays "Null" this means that the user did not define a variable to be stored in this field.
Null	This field contains the value of a user-defined storage variable that was stored in the internal data logger. If this field displays "Null" this means that the user did not define a variable to be stored in this field.

Null	This field contains the value of a user-defined storage variable that was stored in the internal data logger. If this field displays “Null” this means that the user did not define a variable to be stored in this field.

When the user displays the View Storage screen, the monitor displays the latest data record that was saved to the internal data logger. The “storage pointer” also will be located at the latest data record that was saved to the internal data logger. Press the right (<→>) and left (<←>) arrow keys to move the storage pointer and to display other data records stored in the monitor’s internal data logger. To move the storage pointer to (and view) the next highest data record, press the right (<→>) arrow key. For example, if the user was viewing data record number 78 and wanted to move the storage pointer to data record number 79, they would press the right (<→>) arrow key. To move the storage pointer to the next lowest data record, press the left (<←>) arrow key. To move the storage pointer forward by 10 data records at a time, press the <SHIFT> key and hold it down while pressing the right (<→>) arrow key. To move the storage pointer backward by 10 data records at a time, press the <SHIFT> key and hold it down while pressing the left (<←>) arrow key. To move the storage pointer forward by 100 data records at a time, press the <CTRL> key and hold it down while pressing the right (<→>) arrow key. To move the storage pointer backward by 100 data records at a time, press the <CTRL> key and hold it down while pressing the left (<←>) arrow key. To move the storage pointer to the beginning of the storage buffer (to the very first data record stored), press the <FIRST/LAST> key. To move the storage pointer to the end of the storage buffer (to the very last data record stored), press the <SHIFT> key and hold it down while pressing the FIRST/LAST> key.

To view data after they have been downloaded from the monitor, refer to Section 8.

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Section 9: Data Input and Output

This section describes how to use the 3 user-definable analog outputs, 2 user-definable contact closure circuits and 1 analog output. This section also explains how to download data through the RS232 port to a serial printer, PC and other data capture devices, such as a data logger.

9.1. Analog Inputs

The standard configuration of the Series 1400a control unit contains six inputs on the external analog connector (EXT ANALOG) located on the back of the control unit (Figure 9-1), and one analog input on the two, identical 15-pin analog I/O (ANALOG I/O) connector located on the front and back of the control unit (Figures 9-1 and 9-2).

Figure 9-1. Back view of the control unit with the 15-pin external analog input connector (A), auxiliary connector for ACCU System (B), 9-pin serial connector (C) and the 15-pin analog I/O connector (D) highlighted.

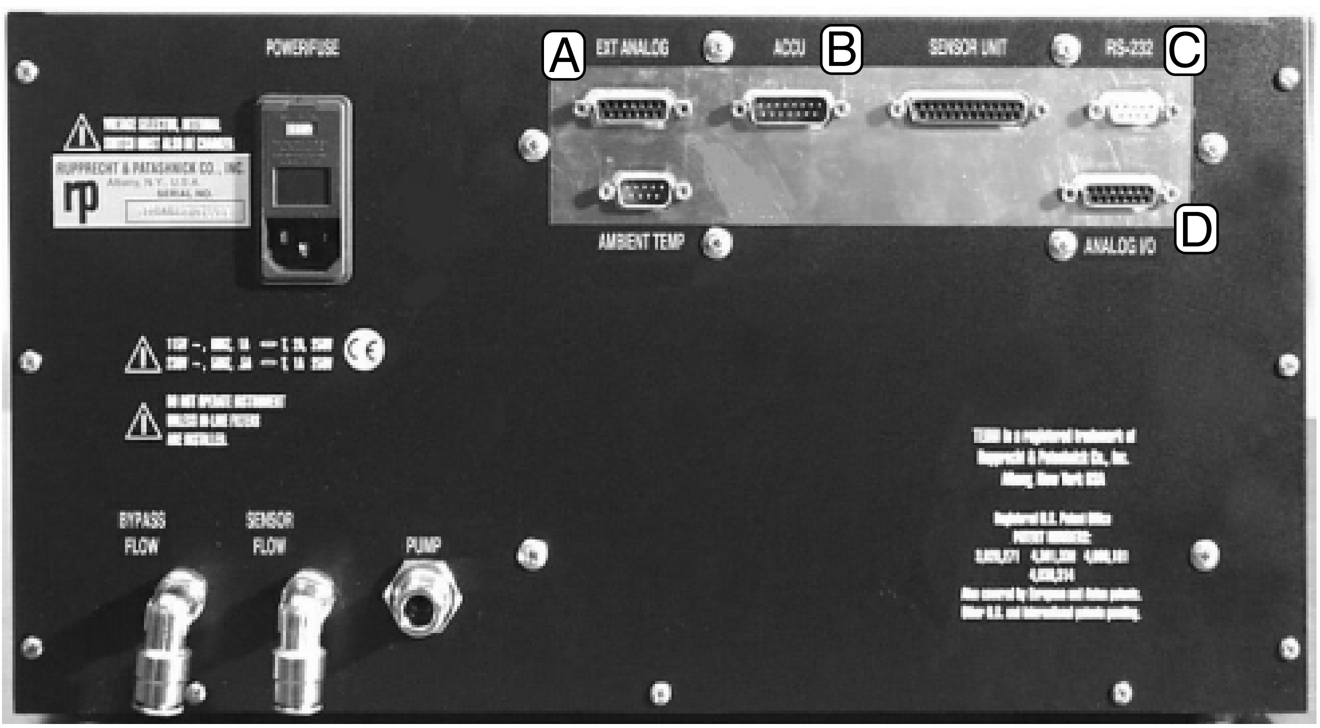
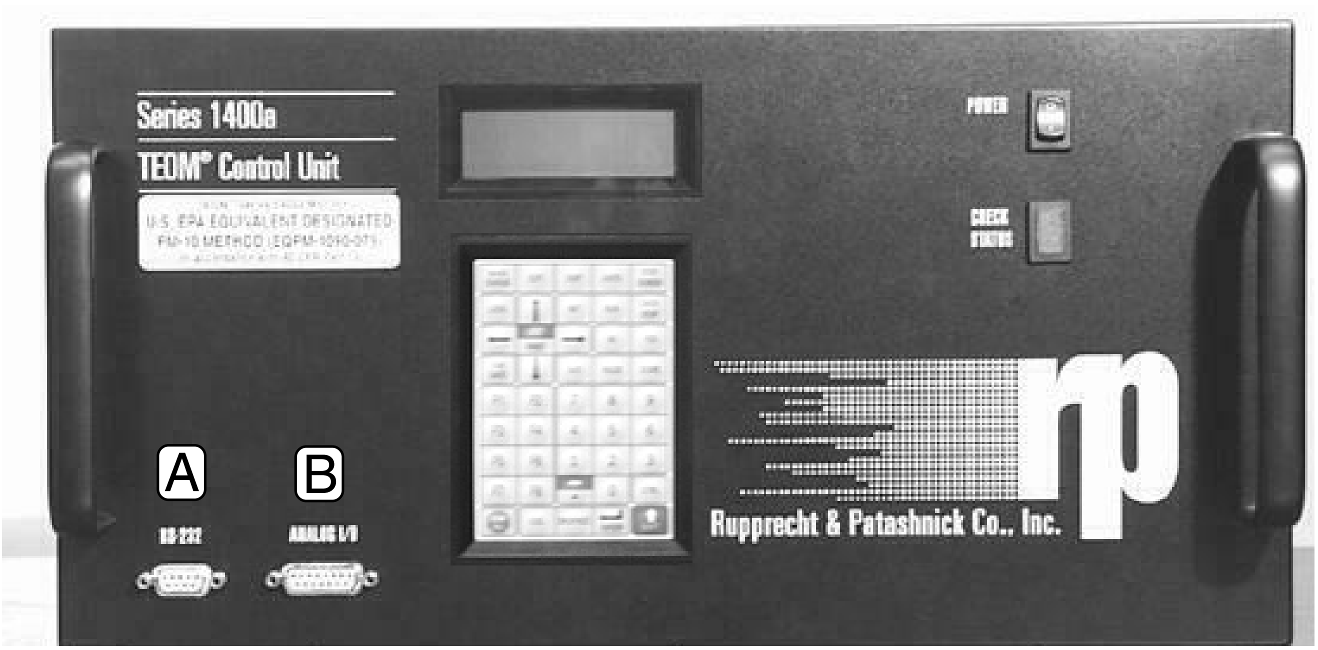


Figure 9-2. Front view of the control unit with the 9-pin RS232 serial connector (A) and the 15-pin analog connector (B) highlighted.



The six inputs on the EXT ANALOG connector and one analog input on the 15-pin ANALOG I/O connector located on the back of the control unit are used by the monitor to identify the switching valve position and the cooler status condition, and in its dew point calculations and cannot be configured by the user. However, the user may use analog input “O” on the 15-pin ANALOG I/O connector located on the front of the control unit.

The analog input “O” can be configured as ±2 VDC, ±10 VDC full scale (-100% to 100%), or 4-20 mA. The specification for this analog input is an input impedance of 24 K ohms. Pin 7 is designated as the signal line, and pin 8 is designated as the ground line. The jumper setting of analog input ”4” on the L-shaped analog input/output board (Figures 9-3, 9-4 and 9-5) (that is located inside the control unit) determines whether this input is configured for 2 VDC, 10 VDC or 4-20 mA. The default setting for analog input channel “0” is 10 VDC.

Figure 9-3. Analog input/
output jumper settings.

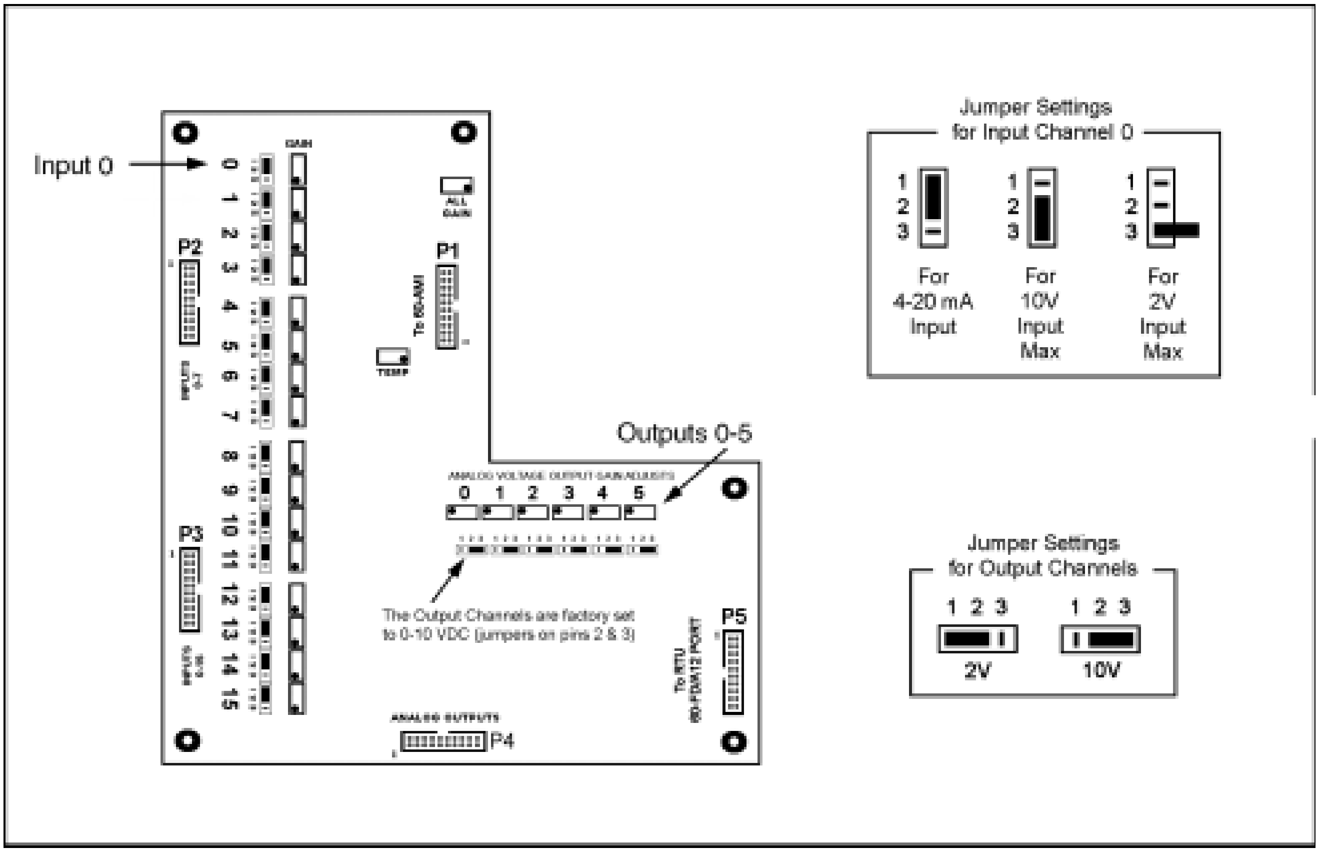


Figure 9-4. Analog input
jumpers.

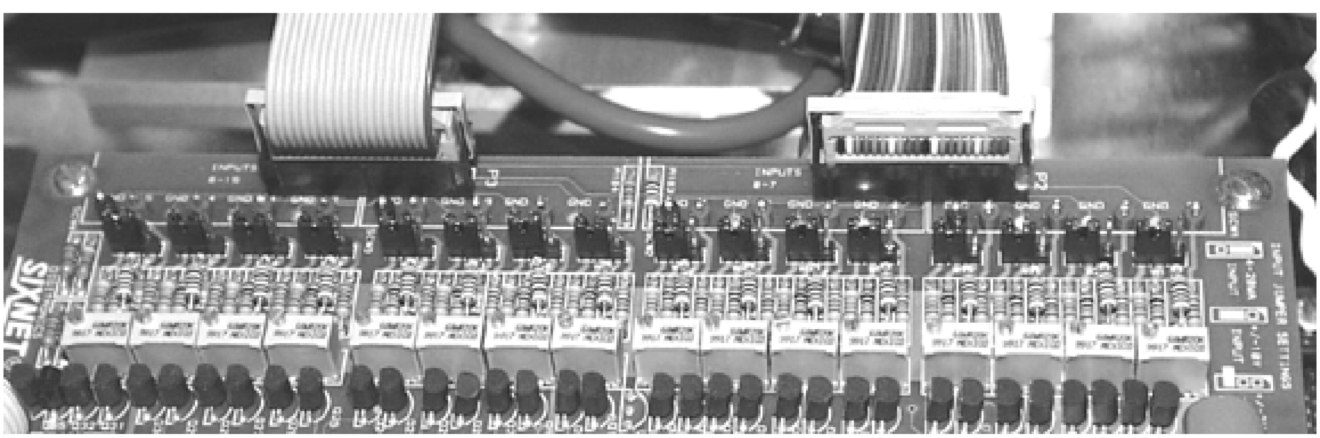
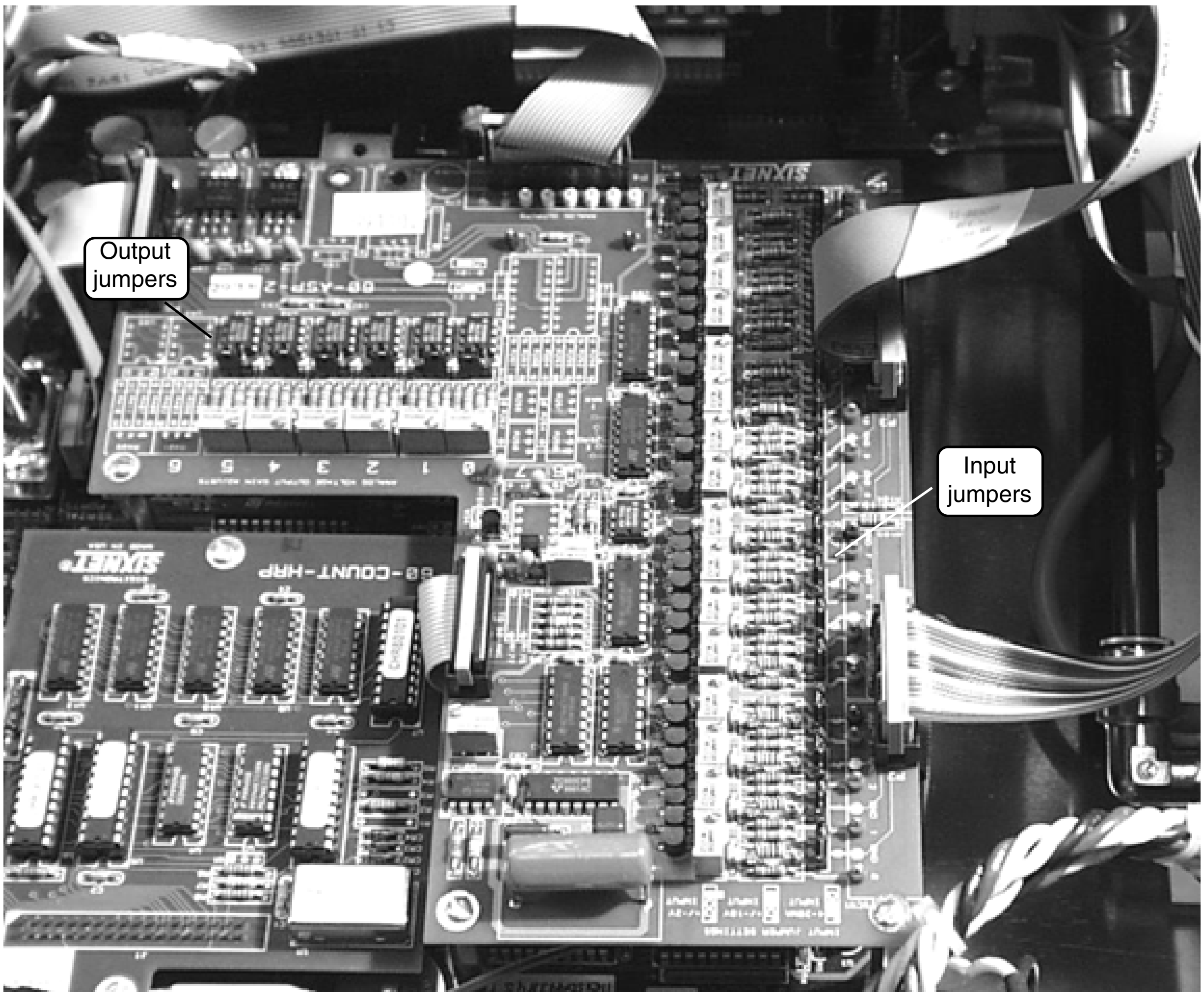


Figure 9-5. L-shaped analog input/output board located inside the control unit.



The following values define the location of analog input channel “0” on the 15-pin analog I/O (ANALOG I/O) connector on the front of the control unit:

Input Channel	Signal	Ground	Location on L-shaped board
0	Signal pin 7	Ground pin 8	Analog board channel 4

9.1.1. View Analog Inputs Screen

The View Analog Inputs screen (Figure 9-6) displays the current values of the monitor’s analog inputs.

Figure 9-6. View Analog Inputs screen.

```
    VIEW ANALOG INPUTS
A/I 0       >       0.000
A/I 1              17.363
A/I 2              27.463
```

You can display the View Analog Inputs screen on the four-line display of the control unit in two different ways:

1. In the Main screen (Figure 9-7), press <STEP SCREEN> to display the Menu screen (Figure 9-8). When in the Menu screen, press the up and down arrow keys to select “View Analog Inputs,” and then press <ENTER>.
2. Press <2> and <3>, and then press <ENTER>.

Figure 9-7. Main screen.

```
OK    4+  21%  NU    09:39
Mass Conc             11.5
01-Hr MC              12.5
08-Hr MC               8.3
```

Figure 9-8. Menu screen.

```
  LISTING OF SCREENS
> Set Temps/Flows
  Set Hardware
  View Analog Inputs
```

The View Analog Inputs screen contains additional lines that cannot be seen when the screen first displays on the control unit’s four-line display (Figure 9-9). Press the up and down arrow keys to view the additional lines of the View Analog Inputs screen.

Figure 9-9. View Analog Inputs screen with additional lines displayed.

```
     VIEW ANALOG INPUTS
A/I 0>              0.000
A/I 1              17.363
A/I 2              27.463
A/I 3              15.957
A/I 4               1.640
A/I 5               2.983
A/I 6              41.885
```

The View Analog Inputs screen contains the following information:

A/I 0	This field contains the average analog input "0" (engineering units) value. The averaging time is determined by the interval parameter set on the Set Storage screen (Section 6). The average input value for analog input channel 0 is assigned program register code (PRC) 114 (Appendix B).
A/I 1	This field contains the average analog input "1" (engineering units) value. Do not change this parameter.
A/I 2	This field contains the average analog input "2" (engineering units) value. Do not change this parameter.
A/I 3	This field contains the average analog input "3" (engineering units) value. Do not change this parameter.
A/I 4	This field contains the average analog input "4" (engineering units) value. Do not change this parameter.
A/I 5	This field contains the average analog input "5" (engineering units) value. Do not change this parameter.

A/I 6	This field contains the average analog input "6" (engineering units) value. Do not change this parameter.

The program register code (PRC) that is assigned for analog input channel 0 (PRC 114) can be stored in the monitor's internal data logger and queried over the RS232 connector.

9.1.2. Define Analog Inputs (A/I) Screen

The user can define the data conversion from analog voltages to engineering units for analog input channel "0" only when in the Define Analog Inputs (A/I) screen (Figure 9-10).

Figure 9-10. Define Analog Inputs (A/I) screen.

```
DEFINE A/I              0
A/I %FS  >           4.83
A/I Type        Mass Conc
Const A             0.000
```

You can display the Define Analog Inputs screen on the four-line display of the control unit in two different ways:

1. In the View Analog Inputs screen (Section 9.1.1), press <STEP SCREEN> on the control unit keypad.
2. Press <2> and <1>, and then press <ENTER>.

The Define Analog Inputs screen contains additional lines that cannot be seen when the screen first displays on the control unit's four-line display (Figure 9-11). Press the up and down arrow keys to view the additional lines of the Define Analog Inputs screen.

Figure 9-11. Define Analog Inputs (A/I) screen with additional lines displayed.

```
DEFINE A/I              0
A/I %FS  >           4.83
A/I Type        Mass Conc
Const A             0.000
-------------------------
Const B             1.000
Const C             0.000
A/I Ave             0.000
```

The Define Analog Inputs screen contains the following information:

0	This field contains the current analog input channel that is being defined. Press the left or right arrow keys to move backward or forward by one channel. To view the first channel, press and hold <CTRL> while pressing the left arrow key. To view the last channel, press and hold <CTRL> while pressing the right arrow key.
A/I %FS	This field contains the current percentage of the analog input's full scale.
A/I Type	This field contains the type of analog input to which the user sets the current analog input channel. This parameter is usually set to "Equation," indicating a regular conversion, using the conversion formula.
Const A	This field contains conversion factor "A" that is used in the conversion formula to convert the analog input value to engineering units.
Const B	This field contains conversion factor "B" that is used in the conversion formula to convert the analog input value to engineering units.
Const C	This field contains conversion factor "C" that is used in the conversion formula to convert the analog input value to engineering units.
A/I Ave	This field displays the average input (engineering units) for the current analog input channel (Section 9.1.1).

Press <LAST/FIRST> to reset the averaging of all seven analog input channels.

For analog input channel "0," the monitor can convert the incoming voltage signal of 10 VDC, 2 VDC or 4-20 mA into engineering units. Because the instrument cannot tell whether the jumper for analog input channel "0" is set to 10 VDC (default), 2 VDC or 4-20 mA, the incoming signal is expressed as a percentage of full scale (-100% to 100%). For example, if analog input channel "0" is configured as 10 VDC, -100% represents a voltage of -10 VDC, and 100% represents a voltage of 10 VDC. The location of the analog input jumpers is shown in Figures 9-3, 9-4 and 9-5.

The conversion formula used by the monitor to convert the analog input value to engineering units is:

$$\text{Result} = \text{Const A} + \text{Const B(A/I \%FS)} + \text{Const C (\%A/I FS)}^2$$

"Const A," "Const B" and "Const C" may be defined differently for each analog input channel "0," and "A/I %FS" is an analog input's percentage of full scale.

In the instrument's default configuration, the Const A and Const C values are set to "0," and the value of Const B is set to "1." In Figure 9-11, the average analog inputs displayed are the percentage of full scale.

9.2. Analog Outputs

The user can access the instrument's three analog output channels from the two identical 15-pin connectors on the front and back panels of the control unit (Figures 9-1 and 9-2).

The pin assignments of the three analog outputs are:

Channel 1	Positive Pin 10	Ground Pin 3
Channel 2	Positive Pin 1	Ground Pin 5
Channel 3	Positive Pin 9	Ground Pin 6

These analog outputs have an output impedance less than 1 ohm and a maximum output current of 10 mA. They can be scaled to 1, 2, 5 or 10 VDC by means of a combination of software (Section 9.2.1) and hardware (Section 9.2.2) settings.

9.2.1. Set Analog Outputs Screen

The Set Analog Outputs screen (Figure 9-12) allows users to define the analog outputs transmitted by the monitor.

Figure 9-12. Set Analog Outputs screen.

```
   SET ANALOG OUTPUTS
Max Volt >         10-VDC
A01 Var          01-Hr MC
A01 Min              0.00
```

You can display the Set Analog Outputs screen on the four-line display of the control unit in three different ways:

1. Press <A/O> on the keypad.
2. In the Main screen (Figure 9-7), press <STEP SCREEN> to display the Menu screen (Figure 9-8). In the Menu screen, press the up and down arrow keys to select "Set Analog Outputs," and then press <ENTER>.
3. Press <0> and <4>, and then press <ENTER>.

The Set Analog Outputs screen contains additional lines that cannot be seen when the screen first displays on the control unit's four-line display (Figure 9-13). Press the up and down arrow keys to view the additional lines of the Set Analog Outputs screen.

Figure 9-13. Set Analog Outputs screen with additional lines displayed.

```
   SET ANALOG OUTPUTS
Max Volt >         10-VDC
A01 Var          01-Hr MC
A01 Min              0.00
-------------------------
A01 Max            500.00
A02 Var          08-Hr MC
A02 Min              0.00
A02 Max            500.00
A03 Var          Tot Mass
A03 Min              0.00
A03 Max           5000.00
Jumpers            10-VDC
```

The Set Analog Outputs screen contains the following information:

Max Volt	This field contains the full scale voltage setting. The range for this variable is 1, 2, 5, or 10 VDC. If you are unable to select 5 or 10 VDC while setting this variable, then you must change the setting for the Jumpers variable to 10 VDC.
AO1 Var	This field contains the PRC value of analog output 1, that will be output. Whenever a variable is assigned to one of the analog output channels, the PRCs for the variable's name, minimum value, and maximum value are all assigned to that channel. In the case of a 10 VDC output, the minimum value for the selected output variable is set to 0 VDC and the maximum value is set to 10 VDC. The behavior of analog output channel 1 can be modified if the user chooses to use the channel as a status indicator.
AO1 Min	This field contains the minimum value setting of the output PRC for analog output 1.
AO2 Max	This field contains the maximum value setting of the output PRC for analog output 1.
AO2 Var	This field contains the PRC value of analog output 2, that will be output. Whenever a variable is assigned to one of the analog output channels, the PRCs for the variable's name, minimum value, and maximum value are all assigned to that channel. In the case of a 10 VDC output, the minimum value for the selected output variable is set to 0 VDC and the maximum value is set to 10 VDC.
AO2 Min	This field contains the minimum value setting of the output PRC for analog output 2.
AO2 Max	This field contains the maximum value setting of the output PRC for analog output 2.

AO3 Var	This field contains the PRC value of analog output 3, that will be output. Whenever a variable is assigned to one of the analog output channels, the program register codes for the variable's name, minimum value, and maximum value are all assigned to that channel. In the case of a 10 VDC output, the minimum value for the selected output variable is set to 0 VDC and the maximum value is set to 10 VDC.
AO3 Min	This field contains the minimum value setting of the output PRC for analog output 3.
AO3 Max	This field contains the maximum value setting of the output PRC for analog output 3.
Jumpers	This field contains the jumper settings of the three analog output channels in the analog output hardware. In the default configuration, the analog output jumpers are set to 10 VDC. In most cases, the value for the jumpers variable should remain at 10 VDC, and no change must be made to the hardware.

In a typical installation, one of the monitor's three analog outputs will be defined as the instantaneous mass concentration average (PRC 8), and this output will be scaled for output over a range of -100 to +900. This output is transmitted to a data logger that is set for a 1-hour averaging time.

The instrument has an analog output resolution of 12 bits including the sign. If the user wants the monitor to produce 1 or 2 VDC analog outputs, the user can change the jumpers in the monitor to their alternate setting of 2 VDC to receive the best voltage resolution.

An appropriate analog output voltage setting depends on the input characteristics of the instrument receiving the signal (for example, the data logger) from the monitor. Consult the operating instructions that came with that instrument to determine what range of voltages it will accept, and adjust the Series 1400a control unit analog output voltage levels from their factory settings (10 VDC) to correspond with it, if necessary.

9.2.2. Changing Analog Output Jumpers

Follow these steps to make hardware and software changes for 10 VDC or 2 VDC analog outputs:

✓ Always wear appropriate anti-static devices when working with the system electronics.

1) **Unplug the monitor from its power source.**
2) **Attach an antistatic wrist strap to your wrist. Attach the other end of the wrist strap to the chassis of the control unit to discharge any static electricity while working on the unit.**

   NOTE: Always wear appropriate anti-static devices when working with the system electronics.

3) **Remove the cover of the control unit (Section 2).**
4) **Locate the L-shaped analog input/output board (Figures 9-3, 9-4 and 9-5).**
5) **Locate the analog output jumpers (Figures 9-14 and 9-15) on the analog input/output board. The jumpers are black plastic sleeves that cover 2 of the 3 pins corresponding to each output channel.**

Figure 9-14. Close-up view of analog output jumpers.

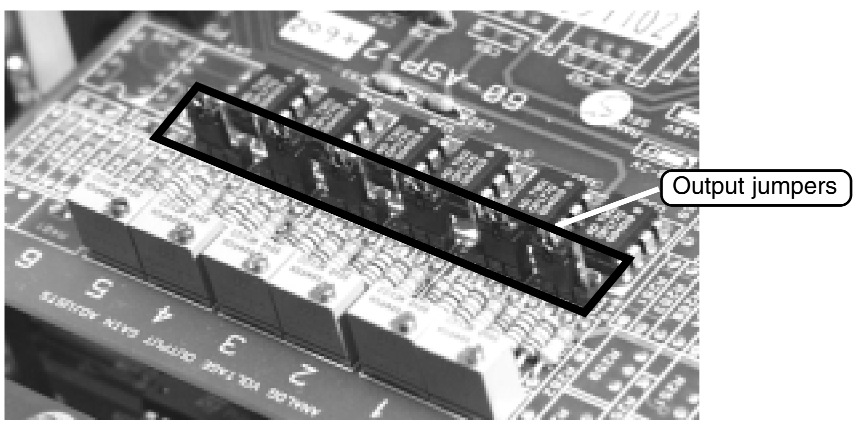
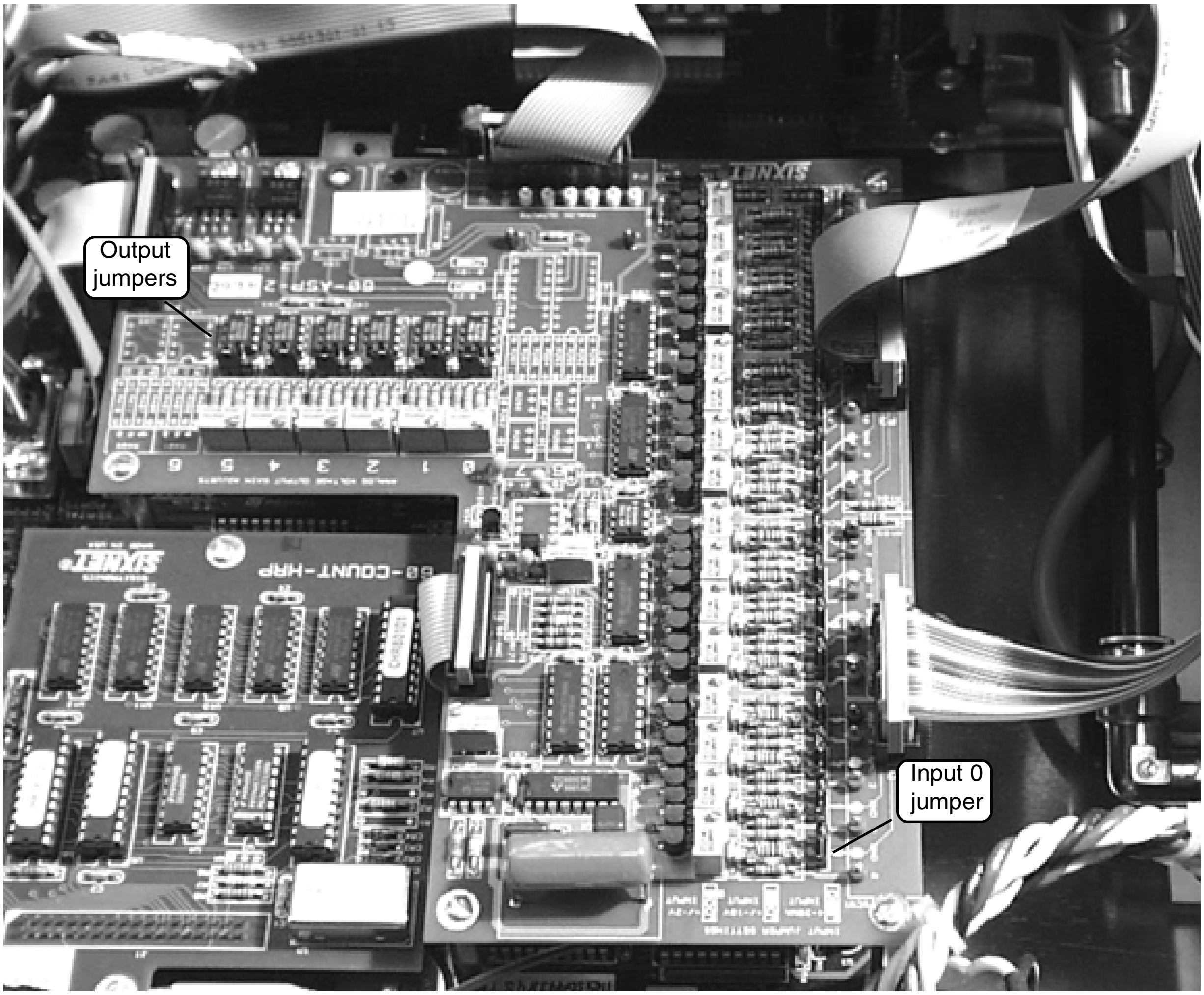


Figure 9-15. L-shaped analog input/output board located inside the control unit.



6) **Locate the jumper for output channel 1. Lift the jumper off of the two pins that it covers (pins 2 and 3), and replace it over the middle pin and the other pin that was not previously covered (pins 1 and 2).**

7) **To change the jumper settings for output channels 2 and 4, repeat step 6.**

NOTE: To change the analog output jumpers hardware settings back to 10 VDC, replace the jumpers to pins 2 and 3. Ensure that the software settings are changed accordingly.

8) Replace the cover of the control unit.

9) Plug the monitor into its power source.

10) Turn on the monitor.

11) Press <A/O> on the keypad. This will display the Set Analog Outputs screen (Figure 9-12).

12) Press <EDIT>.

13) Change the value for the "Jumpers" variable(s) in the appropriate fields (Section 9.2.1).

IMPORTANT: The three analog outputs, 1, 2 and 4, must always be set to the same voltage scale.

14) Check the calibration of the analog board (Service Manual).

9.3. Contact Closure Circuits

The user can monitor the unit's operation and filter life by using two user-definable reed relay contacts that open or close when certain status conditions occur. In their default settings, the monitor's contact closure circuits respond to status conditions and the filter loading percentage (Figure 9-16).

Figure 9-16. Default configuration of contact closures.

	Reed Relay Closed	Reed Relay Open
Contact Closure Circuit 1	DATA VALID Status codes M, T or F are not active.	DATA INVALID Status codes M, T or F are active.
Contact Closure Circuit 2	FILTER LOAD PERCENTAGE OK Percent of filter remaining is less than 90%.	FILTER NEEDS EXCHANGE Percent of filter remaining is greater than 90%.

The pin assignments to the contact closure relays (Figure 9-17) can be found on the 15-pin analog connectors on the front and back panels of the control unit. The contact closure relay can be used for voltages up to 200 VAC or 200 VDC, and currents as high as 10 mA.

Figure 9-17. Pin assignments of contact closures 1 and 2 on 15-pin analog output connector.

	Voltage In	Voltage Out
Circuit 1	Pin 11	Pin 2
Circuit 2	Pin 12	Pin 4

9.3.1. Set Contact Closure Screen

The user can define the operation of the contact closure circuits in the Set Contact Closure screen (Figure 9-18). This programmability allows the user to tailor the channels to a variety of alarm conditions that may exist at different sites.

Figure 9-18. Set Contact Closure screen.

```
   SET CONTACT CLOSURE
Cont1 Prc >        Status
  NAND               7.00
Cont2 Prc       Pres Drop
```

You can display the Set Contact Closure screen on the four-line display of the control unit in three different ways:

1. Press <A/O> on the keypad. This will display the Set Analog Outputs screen (Figure 9-9). In the Set Analog Outputs screen, press <STEP SCREEN>.
2. In the Main screen (Figure 9-7), press <STEP SCREEN> to display the Menu screen (Figure 9-8). In the Menu screen, press the up and down arrow keys to select “Set Contact Closure,” and then press <ENTER>.
3. Press the <2> key twice, and then press <ENTER>.

The Set Contact Closure screen contains additional lines that cannot be seen when the screen first displays on the control unit’s four-line display (Figure 9-19). Press the up and down arrow keys to view the additional lines of the Set Contact Closure screen.

Figure 9-19. Set Contact Closure screen with additional lines displayed.

```
   SET CONTACT CLOSURE
Cont1 PRC >        Status
  NAND               7.00
Cont2 PRC       Pres Drop
-------------------------
     <              90.00
```

The Set Contact Closure screen contains the following information:

Cont1 PRC	This field contains the program register code (PRC) (Appendix B) of the variable whose current value is to be tested. When in the Edit Mode, use the up and down arrow keys to select the appropriate PRC from a list of predefined settings.
NAND	This field contains the comparison or logical operator (<=, <, =, >, >=, <>, AND or NAND) used to compare Cont1 PRC and the constant value. When in the Edit Mode, use the up and down arrow keys to select the appropriate operator from a list of predefined settings.
7.00	This field contains the constant value against which Cont1 PRC is compared.
Cont2 PRC	This field contains the program register code (PRC) (Appendix B) of the variable whose current value is to be tested. When in the Edit Mode, use the up and down arrow keys to select the appropriate PRC from a list of predefined settings.
<	This field contains the comparison operator (<=, <, =, >, >=, <>) or logical operator (AND or NAND) used to compare Cont2 PRC and the constant value. When in the Edit Mode, use the up and down arrow keys to select the appropriate operator from a list of predefined settings.
90.00	This field contains the constant value against which Cont2 PRC is compared.

The monitor performs an evaluation of the designated PRC's current value for each contact closure channel. This test includes a comparison operator (<=, <, =, >, >=, <>) or a logical operator (AND or NAND), and a constant value with which the PRC is compared. If the result of the comparison for an output channel is "true," the monitor closes the circuit (makes contact); otherwise, the channel remains open.

In the monitor's default configuration, contact closure channels 1 and 2 are defined as follows:

Channel 1:	Current Status Code	NAND	7
Channel 2:	Current Filter Pressure Drop	<	90

9.4. Downloading Data

The Series 8500 FDMS Monitor can transmit information to other devices through a number of different means, including analog output, RS232 output, a parallel printer output, user-defined logic level outputs and contact closure. In addition to providing on-line printing capabilities, the instrument directly supports a number of RS232 communication protocols, such as the AK Protocol and the German Ambient Network Protocol (Appendix C). When using the AK Protocol, the user can change the value of system variables and download stored data from a remote location. Also, the instrument can download its stored data records directly to a serial printer or other serial device such as a PC. This section explains how to download data through the RS232 port to a serial printer, PC and other data capture devices, such as a data logger.

Users also can download data files from the Series 8500 FDMS Monitor using PalmOS-based handheld personal computers. Refer to the Palm Pilot PC Operating Manual for instructions on using the PalmOS-based handheld computer to download data from the Series 8500 FDMS Monitor.

Figure 9-20. Set RS-232 Mode screen.

```
     SET RS-232 MODE
 Mode: None
>None
 Print On Line
```

9.4.1. Set RS-232 Mode Screen

The Set RS232 Mode screen (Figure 9-20) allows the user to select an RS232 mode to download the unit's stored data records.

You can display the Set RS232 Mode screen on the four-line display of the control unit in three different ways:

1. Press <RS232> on the keypad.
2. In the Main screen (Figure 9-7), press <STEP SCREEN> to display the Menu screen (Figure 9-8). In the Menu screen, press the up and down arrow keys to select "Set RS-232 Mode," and then press <ENTER>.
3. Press <0> and <5>, and then press <ENTER>.

Figure 9-21. Set RS-232 Mode screen with additional lines displayed.

```
     SET RS-232 MODE
 Mode: None
>None
 Print On Line
-----------------
 AK Protocol
 German Prot
 Store to Print
```

The Set RS232 Mode screen contains additional lines that cannot be seen when the screen first displays on the control unit's four-line display (Figure 9-21). Press the up and down arrow keys to view the additional lines of the Set RS232 Mode screen.

The Set RS232 Mode screen contains the following information:

Mode	This field contains the current RS232 mode.
None	This field contains the None RS232 Mode. When the monitor is in the None Mode, the user can view and change instrument operating parameters using the RPComm software application (Section 9), and upload new system software to the control unit (Appendix D). When the instrument is shipped the RS232 ports are configured for the None Mode.
Print On Line	This field contains the Print On Line RS232 Mode. When the monitor is in the Print On Line Mode, the unit transmits a user-specified line of information, at a user-specified interval. The user sets the information that will be transmitted and the interval at which the information is transmitted in the Com Print Settings screen (Section 9.4.2).
AK Protocol	This field contains the AK Protocol RS232 Mode (Appendix C). When the monitor is in the AK Protocol Mode, the user can retrieve the current value of all system variables over the RS232 connection, change the value of system parameters, and download values stored in the monitor's internal data buffer. The AK Protocol is used in combination with the RPComm software program (Section 9) and the TEOMCOMM software program (Appendix L). The user must set up the unit for transmitting data via the AK Protocol when in the Com 2-Way Settings screen (Section 9.4.3). Refer to Appendix H for further information on modem communications.

German Prot — This field contains the German Ambient Network Protocol RS232 Mode (Appendix C). When the monitor is in the German Ambient Network Protocol Mode, the user can define the Series 8500 FDMS Monitor as a station with up to three predetermined system variables in each response transmission. The user must set up the unit for transmitting data via the German Ambient Network Protocol when in the Com 2-Way Settings screen (Section 9.4.3). Refer to Appendix H for further information on modem communications.

Store to Print — This field contains the Store to Print RS232 Mode. When the monitor is in the Store to Print Mode, the unit downloads all data records (from the storage pointer to the end of the data storage buffer) to a serial printer. The monitor sends one new data record to the serial printer every 2 seconds. If the user leaves the monitor in the Store to Print Mode after the monitor has transmitted the last data record in its data storage buffer, the monitor will continue to transmit stored data records to the serial printer as data records are stored in its data storage buffer. The user sets the rate at which data records are stored in the data storage buffer, and the stored variables that will be downloaded to the serial printer, when in the Set Storage screen (Section 6).

IMPORTANT: The instrument will begin download data to the serial printer immediately after the user changes the RS232 Mode to “Store to Print.” If you want to use this RS232 Mode, be sure to turn on your serial printer and connect it to the monitor BEFORE setting the RS232 Mode to “Store to Print.”

Fast Store Out

This field contains the Fast Store Out RS232 Mode. When the monitor is in the Fast Store Out Mode, the unit downloads all data records (from the storage pointer to the end of the data storage buffer) to a PC or other serial data recording device (such as a data logger). If the user leaves the monitor in the Fast Store Out Mode after the monitor has transmitted the last data record in its data storage buffer, the monitor will continue to transmit stored data records to the PC or other serial data recording device as data records are stored in its data storage buffer. The user sets the rate at which data records are stored in the data storage buffer, and the stored variables that will be downloaded to the PC or other serial data recording device, when in the Set Storage screen (Section 6).

Figure 9-22. Main screen with RS232 Mode field (A) highlighted.

```
                   A
OK     4+  21%  NU      09:39
Mass Conc                11.5
01-Hr MC                 12.5
08-Hr MC                  8.3
```

IMPORTANT: The instrument will begin download data to the PC or other serial data recording device (such as a data logger) immediately after the user changes the RS232 Mode to “Fast Store Out.” If you want to use this RS232 Mode, be sure to turn on your PC or other serial data recording device, connect it to the monitor and set it to retrieve data BEFORE setting the RS232 Mode to “Fast Store Out.”

Figure 9-23. Com Print Settings screen.

```
     COM PRINT SETTINGS
Interval >             1800
Columns                   6
Prnt Var 1         01-Hr MC
```

When the user selects an RS232 Mode, the abbreviation for the selected RS232 Mode displays on the status line of the Main screen (Figure 9-22). The abbreviation for the current RS232 Mode is the first letter of the RS232 Mode’s full name.

9.4.2. Com Print Settings Screen

The Com Print Settings screen (Figure 9-23) allows the user to determine the format of the data download when the monitor is in the Print On Line RS232 Mode (Section 9.4.1). Although the name of the Print On Line Mode implies that the user would only use this RS232 mode when connecting to a serial printer, this is not the case. The user can set the monitor to download data to any type of serial data capture device using the Print On Line Mode.

You can display the Com Print Settings screen on the four-line display of the control unit in two different ways:

1. In the Main screen (Figure 9-7), press <STEP SCREEN> to display the Menu screen (Figure 9-8). In the Menu screen, press the up and down arrow keys to select “Set RS-232 Mode,” and then press <ENTER> to display the Set RS-232 Mode screen (Figure 9-18). In the Set RS-232 Mode screen, press <STEP SCREEN>.
2. Press <0> and <6>, and then press <ENTER>.

Figure 9-24. Com Print Settings screen with additional lines displayed.

```
      COM PRINT SETTINGS
Interval >            1800
Columns                  6
Prnt Var1        01-Hr MC
--------------------------
Prnt Var2        08-Hr Mc
Prnt Var3        12-Hr MC
Prnt Var4        24-Hr MC
Prnt Var5        Tot Mass
Prnt Var6            Null
Station          48048048
```

The Com Print Settings screen contains additional lines that cannot be seen when the screen first displays on the control unit's four-line display (Figure 9-24). Press the up and down arrow keys to view the additional lines of the Com Print Settings screen.

The Com Print Settings screen contains the following information:

Interval	This field contains the time interval (ssss) between data output transmissions. The default setting is 1,800 seconds.
Columns	This field contains the number of data columns (1-6) that the instrument will transmit in each data output transmission. The default setting is 6 columns of data.
Prnt Var1	This field contains the data variable (PRC) that will be transmitted in Column 1 during each data output transmission.
Prnt Var2	This field contains the data variable (PRC) that will be transmitted in Column 2 during each data output transmission.
Prnt Var3	This field contains the data variable (PRC) that will be transmitted in Column 3 during each data output transmission.

Prnt Var4	This field contains the data variable (PRC) that will be transmitted in Column 4 during each data output transmission.
Prnt Var5	This field contains the data variable (PRC) that will be transmitted in Column 5 during each data output transmission.
Prnt Var6	This field contains the data variable (PRC) that will be transmitted in Column 6 during each data output transmission.
Station	This field contains the station number (ASCII character string), which is a representation of a numeric field that can be up to three digits long. The station variable is transmitted during each data transmission and is stored with every data record in the monitor's internal data storage buffer. Refer to Appendix I for a list of ASCII codes. The default setting for the station number is "48048048," which is the ASCII code for "000."

The monitor always outputs the current date and time, and the station identifier, at the beginning of each data output transmission.

9.4.3. Com 2-Way Settings Screen

The Com 2-Way Settings screen (Figure 9-25) allows the user to set up information exchange between the Series 8500 FDMS Monitor and a PC or other serial data recording device, using the AK Protocol or the German Ambient Network Protocol (Appendix C). The AK Protocol is used in combination with the RPComm software program (Section 9) and the TEOMCOMM software program (Appendix L). Refer to Appendix H for further information on modem communications.

Figure 9-25. Com 2-Way Settings screen.

```
     COM 2-WAY SETTINGS
RS-Para 1 >            52
RS-Para 2           75048
RS-Para 3           13010
```

You can display the Com 2-Way Settings screen on the four-line display of the control unit in two different ways:

1. In the Main screen (Figure 9-7), press <STEP SCREEN> to display the Menu screen (Figure 9-8). In the Menu screen, press the up and down arrow keys to select "Set RS-232 Mode," and then press <ENTER> to display the Set RS-232 Mode screen (Figure 9-18). In the Set RS-232 Mode screen, press <STEP SCREEN> to display the Com Print Settings screen (Figure 9-21). In the Com Print Settings screen, press <STEP SCREEN>.
2. Press <0> and <7>, and then press <ENTER>.

The Com 2-Way Settings screen contains additional lines that cannot be seen when the screen first displays on the control unit's four-line display (Figure 9-26). Press the up and down arrow keys to view the additional lines of the Com 2-Way Settings screen.

Figure 9-26. Com 2-Way Settings screen with an additional line displayed.

```
      COM 2-WAY SETTINGS
RS-Para 1 >              52
RS-Para 2             75048
RS-Para 3             13010
---------------------------
RS-Para 4                 0
```

The Com 2-Way Settings screen contains the following information:

RS-Para 1	This field contains an ASCII code. The definition of this parameter depends on whether the user selects the AK Protocol or the German Ambient Network Protocol. This variable must be set to use either the AK Protocol or the German Ambient Network Protocol to transmit data to and from the monitor.
RS-Para 2	This field contains an ASCII code. The definition of this parameter depends on whether the user selects the AK Protocol or the German Ambient Network Protocol. This variable must be set to use either the AK Protocol or the German Ambient Network Protocol to transmit data to and from the monitor.
RS-Para 3	This field contains an ASCII code. The definition of this parameter depends on whether the user selects the AK Protocol or the German Ambient Network Protocol. This variable must be set to use the German Ambient Network Protocol to transmit data to and from the monitor.
RS-Para 4	This field contains an ASCII code. The definition of this parameter depends on whether the user selects the AK Protocol or the German Ambient Network Protocol.

9.4.4. Downloading Data — One-Way Communication

The user can download data directly from the unit to a serial printer, PC, or other serial data recording device. The instructions in this section explain a one-way data transmission, which is transmitting data only from the unit to another data capture device.

9.4.4.1. Fast Store Out Mode

The user can set up the monitor to download data records using the Fast Store Out Mode before they have been recorded, while they are being recorded, or after they have been recorded. Data transmitted through the Fast Store Out mode are delimited by commas for simplified use in spreadsheet programs. Keypad response to user inputs is diminished when the instrument is in the Fast Store Out Mode due to the high rate at which the RS232 port is accessed. This does not have any effect on the collection, calculation or storage of data in the instrument.

Follow these steps to download data using the Fast Store Out Mode:

1) **Connect one end of the 9-to-9 pin computer cable to one of the RS232 ports on the control unit.**
2) **Ensure that nothing is connected to the other RS232 port of the control unit.**
3) **If your PC or other serial data recording device is equipped with a 9-pin RS232 connector, go to step 4. If your PC or other serial data recording device is equipped with a 25-pin connector, go to step 5.**
4) **Plug the other end of the 9-to-9 pin computer cable into the 9-pin RS232 port of your PC or other serial data recording device. Go to step 8.**
5) **Locate the 9-to-25 pin computer cable adapter.**
6) **Plug the 9-to-25 pin computer cable adapter into the 25-pin port on your PC or other serial data recording device.**
7) **Plug the other end of the 9-to-9 pin computer cable into the 9-to-25 pin computer cable adapter. Go to step 8.**

   NOTE: Do not use the 9-to-25 pin modem cable to connect the control unit with the PC or other serial data recording device. The 9-to-25 pin modem cable is configured for use only with a modem.

8) To set the storage pointer to the first data record to be downloaded, go to step 9. If you do not want to move the storage pointer, go to step 12.

9) Press <STORE> on the keypad to display the View Storage screen (Figure 9-27).

Figure 9-27. View Storage screen.

```
VIEW STORAGE             2056
16:20:03            15-Jun-04
>01-Hr MC                34.9
 24-Hr MC                12.3
```

10) Press the right and left arrow keys to move the storage pointer to the data record where you want the data download to begin (Section 8).

11) Press and hold the <CTRL> key, then press <LAST/FIRST>. This will move the storage pointer to the data record just before your "beginning" data record.

12) Initiate the data capture software (such as TEOMCOMM or RPComm) on your PC or other serial data recording device (such as a data logger).

13) Ensure that the data capture software is set for the same communication parameters as the instrument. The default settings of the monitor are:

Baud rate	9600
Data bits	8
Parity	None
Stop bits	1

14) Set the data capture software to the "data capture" or "data download" mode.

15) Press <RS232> on the keypad to display the Set RS-232 Mode screen (Figure 9-20).

16) In the Set RS-232 Mode screen, press <EDIT>.

17) Press the up and down arrow keys to select "Fast Store Out."

18) Press <ENTER>. The instrument will begin downloading data to the PC or other serial data recording device (such as a data logger) immediately after pressing <ENTER>.

NOTE: If you leave the monitor in the Fast Store Out Mode after the monitor has transmitted the last data record in its data storage buffer, the monitor will continue to transmit stored data records to the PC or other serial data recording device as data records are stored in its data storage buffer. The user sets the rate at which data records are stored in the data storage buffer, and the stored variables that will be downloaded to the PC or other serial data recording device, when in the Set Storage screen (Section 6).

19) When the data download is complete, set the RS232 protocol to "None."

20) Disconnect the RS232 cable from the monitor and the PC or other serial data recording device.

9.4.4.2. Print On Line Mode

The user must set up the monitor to download data records using the Print On Line Mode before they have been recorded. This RS232 protocol will download data to a PC or other serial recording device while the unit is recording data records.

Follow these steps to download data using the Print On Line Mode:

1) **Connect one end of the 9-to-9 pin computer cable to one of the RS232 ports on the control unit.**
2) **Ensure that nothing is connected to the other RS232 port of the control unit.**
3) **If your PC or other serial data recording device is equipped with a 9-pin RS232 connector, go to step 4. If your PC or other serial data recording device is equipped with a 25-pin connector, go to step 5.**
4) **Plug the other end of the 9-to-9 pin computer cable into the 9-pin RS232 port of your PC or other serial data recording device. Go to step 8.**
5) **Locate the 9-to-25 pin computer cable adapter.**
6) **Plug the 9-to-25 pin computer cable adapter into the 25-pin port on your PC or other serial data recording device.**
7) **Plug the other end of the 9-to-9 pin computer cable into the 9-to-25 pin computer cable adapter. Go to step 8.**

   NOTE: Do not use the 9-to-25 pin modem cable to connect the control unit with the PC or other serial data recording device. The 9-to-25 pin modem cable is configured for use only with a modem.

8) **Press <0> and <6>, and then press <ENTER> to display the Com Print Settings screen (Figure 9-23).**
9) **In the Com Print Settings screen, determine the format of the data download (Section 9.4.2).**
10) **Initiate the data capture software (such as TEOMCOMM or RPComm) on your PC or other serial data recording device (such as a data logger).**

11) Ensure that the data capture software is set for the same communication parameters as the instrument. The default settings of the monitor are:

Baud rate	9600
Data bits	8
Parity	None
Stop bits	1

12) Set the data capture software to the "data capture" or "data download" mode.

13) Press <RS232> on the keypad to display the Set RS-232 Mode screen (Figure 9-20).

14) In the Set RS-232 Mode screen, press <EDIT>.

15) Press the up and down arrow keys to select "Print On Line."

16) Press <ENTER>. The instrument will begin downloading data to the PC or other serial data recording device (such as a data logger) immediately after pressing <ENTER>.

17) When you want to stop downloading data, set the RS232 protocol to "None."

18) Disconnect the RS232 cable from the monitor and the PC or other serial data recording device.

9.4.4.3. Store to Print Mode

The user can set up the monitor to download data records using the Store to Print Mode before they have been recorded, while they are being recorded, or after they have been recorded. The Store To Print mode is designed to transmit information to a serial printer by sending one new record every 2 seconds.

Follow these steps to download data using the Store to Print Mode:

1) **Connect one end of the 9-to-9 pin computer cable to one of the RS232 ports on the control unit.**
2) **Ensure that nothing is connected to the other RS232 port of the control unit.**
3) **If your serial printer is equipped with a 9-pin RS232 connector, go to step 4. If your serial printer is equipped with a 25-pin connector, go to step 5.**
4) **Plug the other end of the 9-to-9 pin computer cable into the 9-pin RS232 port of your serial printer. Go to step 8.**
5) **Locate the 9-to-25 pin computer cable adapter.**
6) **Plug the 9-to-25 pin computer cable adapter into the 25-pin port on your serial printer.**
7) **Plug the other end of the 9-to-9 pin computer cable into the 9-to-25 pin computer cable adapter. Go to step 8.**

   NOTE: Do not use the 9-to-25 pin modem cable to connect the control unit with the serial printer. The 9-to-25 pin modem cable is configured for use only with a modem.

8) **To set the storage pointer to the first data record to be downloaded, go to step 9. If you do not want to move the storage pointer, go to step 12.**
9) **Press <STORE> on the keypad to display the View Storage screen (Figure 9-27).**
10) **Press the right and left arrow keys to move the storage pointer to the data record where you want the data download to begin (Section 8).**
11) **Press and hold the <CTRL> key, then press <LAST/FIRST>. This will move the storage pointer to the data record just before your “beginning” data record.**

12) Ensure that your serial printer is turned on and is ready to begin printing.

13) Press <RS232> on the keypad to display the Set RS-232 Mode screen (Figure 9-20).

14) In the Set RS-232 Mode screen, press <EDIT>.

15) Press the up and down arrow keys to select "Store to Print."

16) Press <ENTER>. The instrument will begin downloading data to the serial printer immediately after pressing <ENTER>.

NOTE: If you leave the monitor in the Store to Print Mode after the monitor has transmitted the last data record in its data storage buffer, the monitor will continue to transmit stored data records to the serial printer as data records are stored in its data storage buffer. The user sets the rate at which data records are stored in the data storage buffer, and the stored variables that will be downloaded to the serial printer, when in the Set Storage screen (Section 6).

17) When the data download is complete, set the RS232 protocol to "None."

18) Disconnect the RS232 cable from the monitor and the serial printer.

9.4.5. Data Downloading — Two-Way Communication

The user can retrieve the current value of all system variables over the RS232 connection, change the value of system parameters, and download values stored in the monitor's internal data buffer using a personal computer (PC), or other serial data recording device. The monitor must be in the AK Protocol or German Ambient Network Protocol RS232 Mode to perform two-way data transmission (Section 9.4.3). The AK Protocol is used in combination with the RPComm software program (Section 9) and the TEOMCOMM software program (Appendix L). The instructions in this section explain a two-way data transmission, which is transmitting data to and from the unit using a PC or other serial data recording device.

Follow these steps to transmit data to and from the monitor:

1) **Connect one end of the 9-to-9 pin computer cable to one of the RS232 ports on the control unit.**
2) **Ensure that nothing is connected to the other RS232 port of the control unit.**
3) **If your PC or serial data recording device is equipped with a 9-pin RS232 connector, go to step 4. If your PC or serial device is equipped with a 25-pin connector, go to step 5.**
4) **Plug the other end of the 9-to-9 pin computer cable into the 9-pin RS232 port of your PC or serial device. Go to step 8.**
5) **Locate the 9-to-25 pin computer cable adapter.**
6) **Plug the 9-to-25 pin computer cable adapter into the 25-pin port on your PC or serial device.**
7) **Plug the other end of the 9-to-9 pin computer cable into the 9-to-25 pin computer cable adapter. Go to step 8.**

   NOTE: Do not use the 9-to-25 pin modem cable to connect the control unit with the PC or serial device. The 9-to-25 pin modem cable is configured for use only with a modem.

8) **Initiate the data capture software (such as TEOMCOMM or RPComm) on your PC.**

9) Ensure that the data capture software is set for the same communication parameters as the instrument. The default settings of the monitor are:

Baud rate	9600
Data bits	8
Parity	None
Stop bits	1

10) Set the data capture software to the “data capture” or “data download” mode.

11) Press <RS232> on the keypad to display the Set RS-232 Mode screen (Figure 9-20).

12) In the Set RS-232 Mode screen, press <EDIT>.

13) Press the up and down arrow keys to select “AK Protocol” or “German Prot” (German Ambient Network Protocol) (Section 9.4.1).

14) Press <ENTER>.

15) Press <0> and <7>, and then press <ENTER> to display the Com 2-Way Settings screen (Figure 9-27).

16) When in the Com 2-Way Settings screen, enter the appropriate parameters for the AK Protocol or German Ambient Network Protocol (Section 9.4.3).

NOTE: If you are using the TEOMCOMM software, select “AK Protocol” in the Set RS-232 Mode screen (step 13), and enter the following default values on the four lines of the Com 2-Way Settings screen:

RS-Para 1	52
RS-Para 2	75048
RS-Para 3	13010
RS-Para 4	0

17) Test the connection by checking to ensure that data can be sent and received using the commands appropriate to the selected RS232 protocol.

18) When the data transmission is complete, set the RS232 protocol to “None.”

19) Disconnect the RS232 cable from the monitor and the PC.

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Section 10: Using RPComm

RPComm is a communications software package developed for Windows 9x/NT/2000/Me/XP to provide interactive remote communications with R&P instrumentation. RPComm also comes in versions for Windows CE and PalmOS-based handheld computers. Refer to the Palm Pilot PC Operating Manual for instructions on using the PalmOS-based handheld computer to download data from the Series 8500 FDMS Monitor. Refer to Appendix A for a complete list of RPComm software screens.

RPComm enables the user to:

- Download the data stored within the unit's internal storage buffers
- Schedule automatic data downloads
- View and graph downloaded data
- View a real-time graph of selected variables
- Remotely operate the unit using a virtual keypad
- Make multiple connections.

System requirements for running RPComm software are:

- Pentium processor
- 64 megabytes (MB) of random access memory (RAM)
- 40 MB of hard drive space.

RPComm has two communication modes — direct and modem. Direct communication is accomplished when the unit has a direct cable connection with a personal computer (PC). Modem communication is accomplished when the unit has a connection with a PC through the use of a modem and phone line (Appendix H). Before modem communication is attempted, direct communication must be successfully completed. This will ensure that the PC and unit have been set up properly for communications.

10.1. Instrument Setup for Direct Communication

To set up the Series 8500 FDMS Monitor for direct communication with a personal computer (PC), you must use the 9-to-9 serial pin cable that is included in the compilation package (Section 2).

Follow these steps to connect the PC to the monitor:

1) Connect one end of the 9-to-9 pin serial cable to the RS232 port on the back of the control unit (Figure 10-1).

Figure 10-1. RS232 port located on the back of the control unit.

2) Ensure that nothing is connected to the other RS232 port of the control unit.

3) If your PC is equipped with a 9-pin RS232 connector, go to step 4. If your PC is equipped with a 25-pin connector, go to step 5.

4) Insert the other end of the 9-to-9 pin serial cable into the 9-pin RS232 port of your PC. Go to step 8.

5) Locate the 9-to-25 pin computer cable adapter.

6) Insert the 9-to-25 pin computer cable adapter into the 25-pin port on your PC.

7) Insert the other end of the 9-to-9 pin serial cable into the 9-to-25 pin computer cable adapter. Go to step 8.

NOTE: Do not use the 9-to-25 pin modem cable to connect the control unit with the PC. The 9-to-25 pin modem cable is configured for use only with a modem.

8) Ensure that the Main screen (Figure 10-2) is displayed on the control unit's four-line display.

Figure 10-2. Main screen.

RS232 mode field

```
OK    4+  21%  AU     09:42
Mass Conc              11.5
01-Hr MC               12.5
08-Hr MC                8.3
```

9) Press <F2> on the keypad until an "A" (AK Protocol Mode) displays in the RS232 Mode field of the Main screen's status line (Figure 10-2). The instrument must remain in the AK Protocol Mode while executing the computer routines described in this section.

10.2. Using RPComm

NOTE: This section assumes that RPComm was installed in the default locations when the installation program was executed (Appendix D).

10.2.1. Starting RPComm

NOTE: The Windows operating system screens shown in this section are from the Windows 98 and XP operating systems. These screens may vary slightly from your computer's screens if you are operating RPComm under other Windows operating systems.

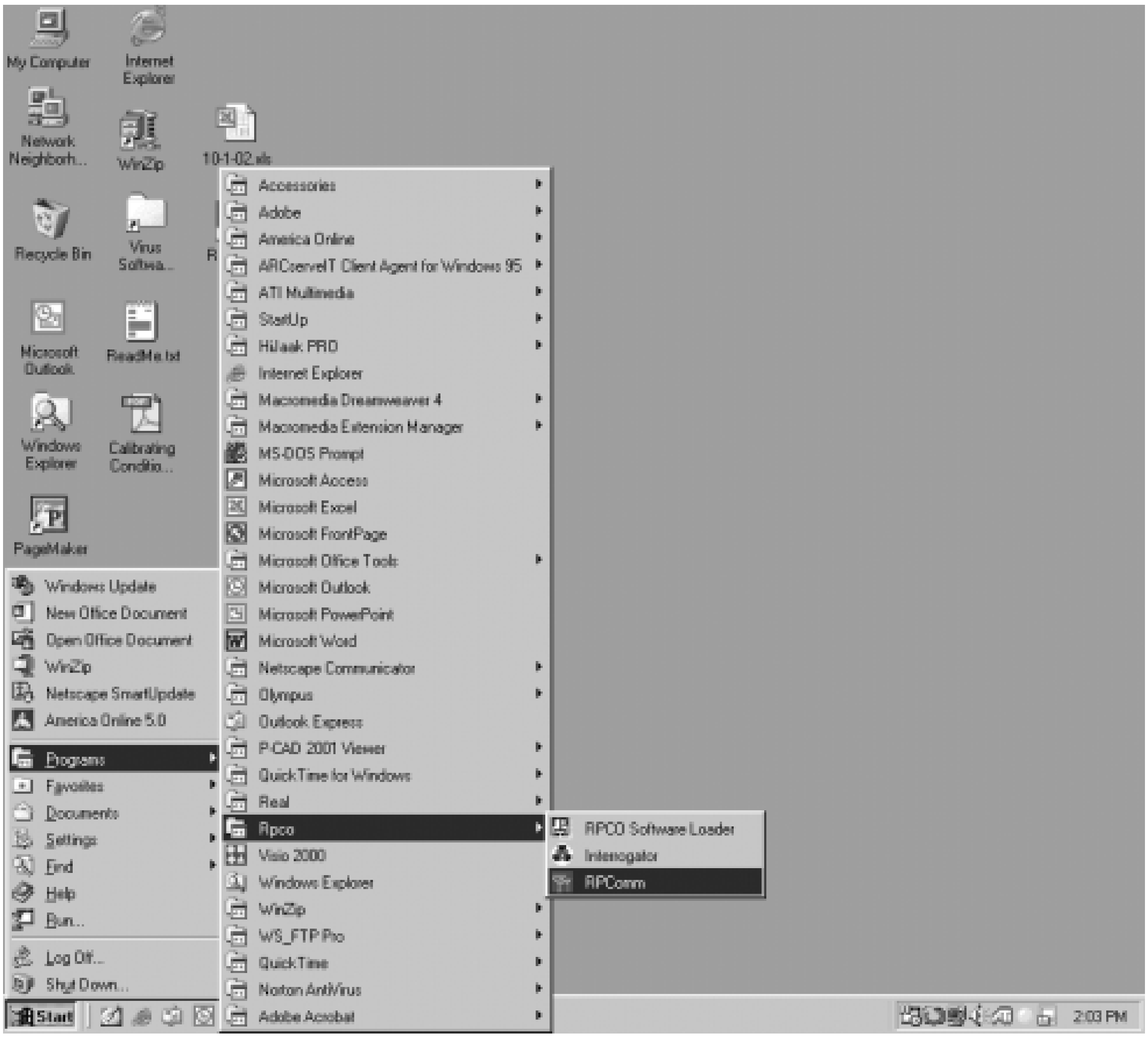
The newest version of RPComm available from the Thermo web site (www.Thermo.com) is equipped with "Autorun." This means that every time you turn on your PC, the RPComm software application will automatically begin running. If you close the RPComm software application to use other software, you may start it manually from the "Start" menu.

Follow these steps to run RPComm:

1) Select the "Start" button on your PC.

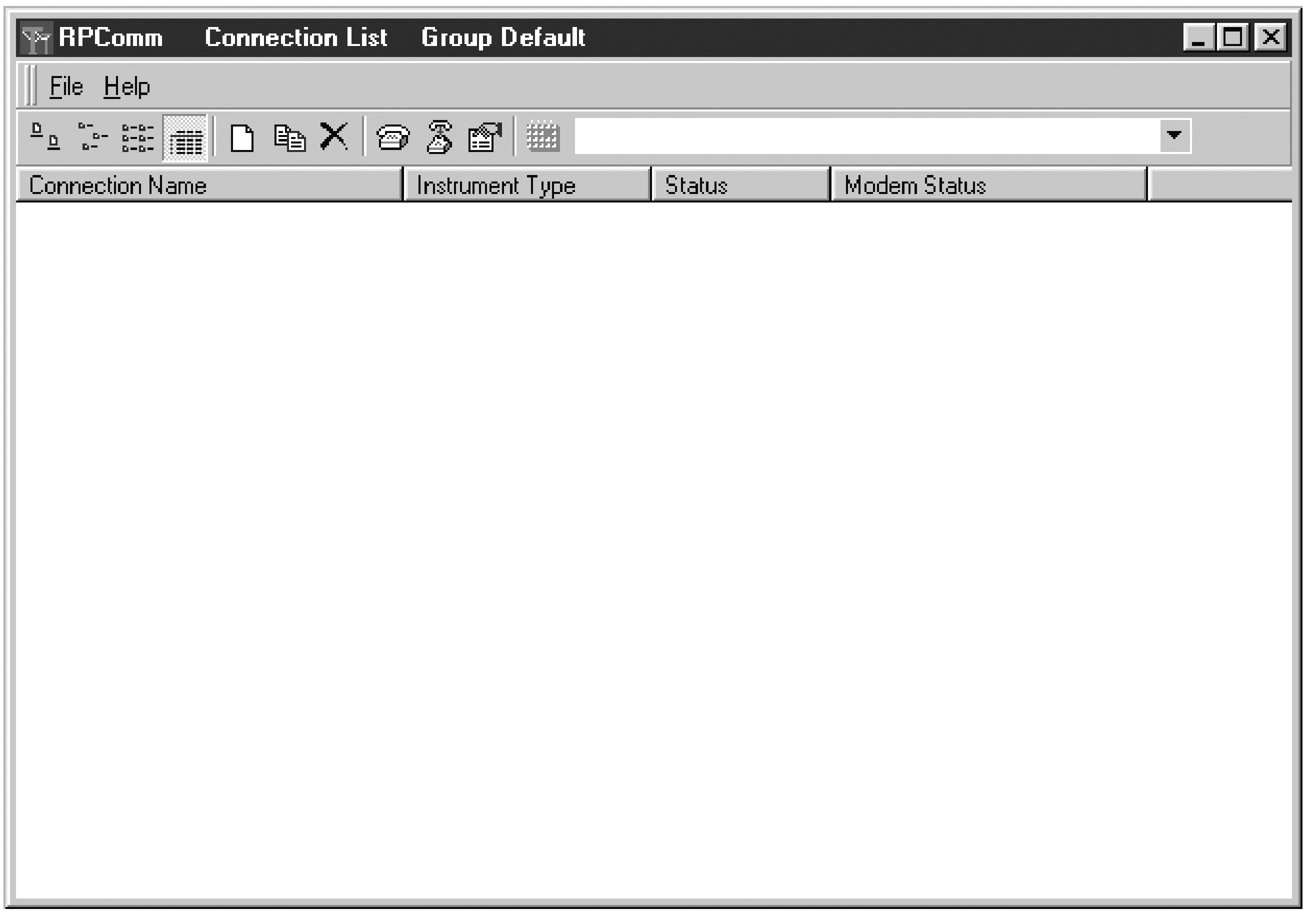
2) When the Start menu displays, select "Programs," the "Rpco" folder and then "RPComm" (Figure 10-3).

Figure 10-3. Selecting Programs from the Start menu, then the Rpco folder and RPComm.



3) When RPComm starts running, the RPComm Connection List screen will display (Figure 10-4).

Figure 10-4. RPComm Connection List screen.

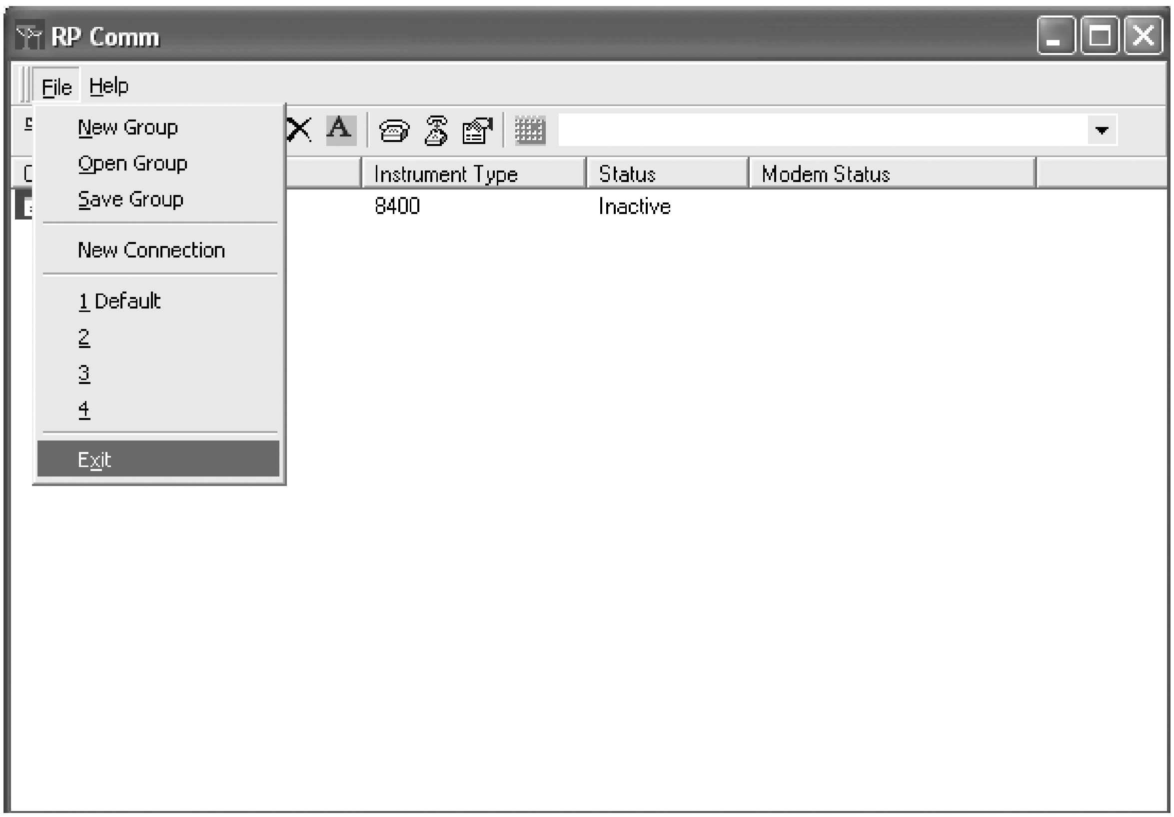


10.2.2. Exiting RPComm

Follow these steps to stop running RPComm:

1) When in the RPComm Connection List screen, select "File" and then "Exit" (Figure 10-5).

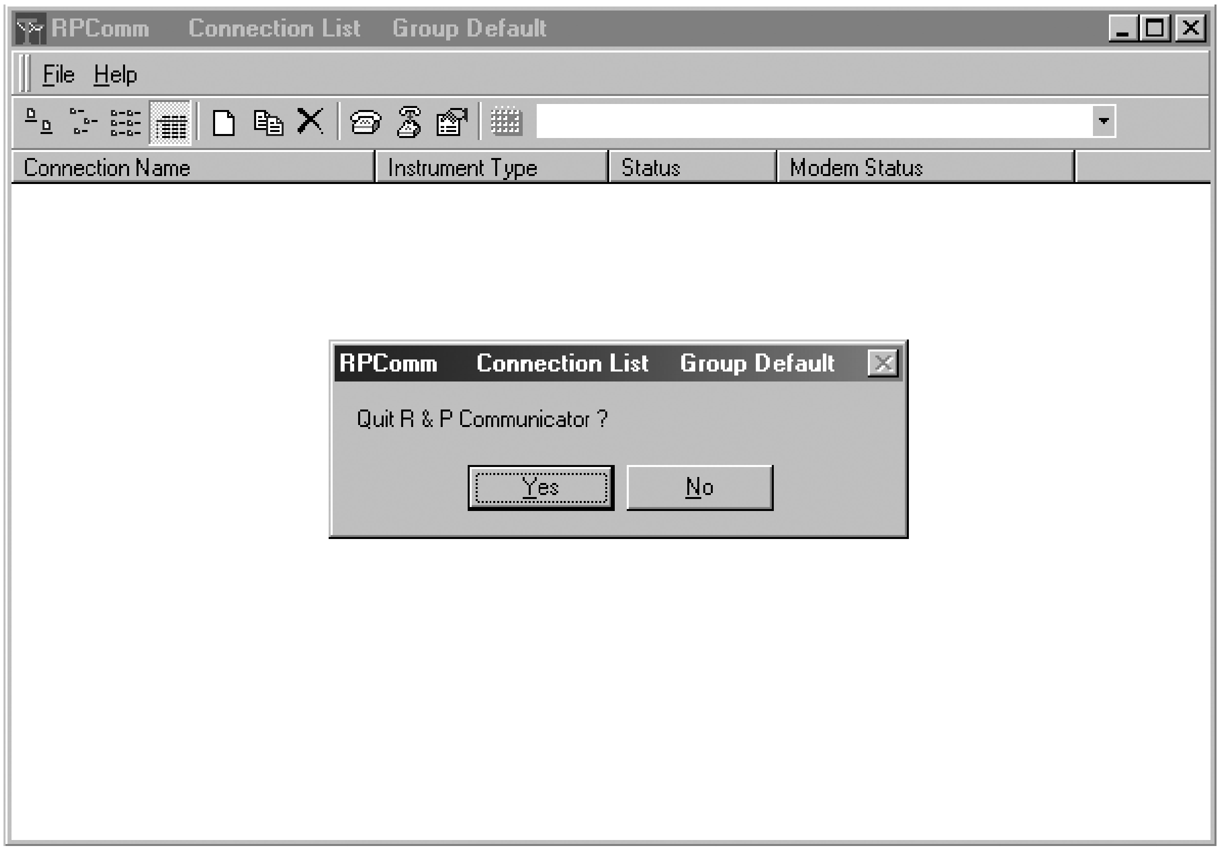
Figure 10-5. Connection List screen with the File menu displayed.



2) **The RPComm Connection List screen will display with a "Quit R & P Communicator?" message (Figure 10-6).**

3) **Select "Yes."**

Figure 10-6. RPComm Connection List screen with "Quit R & P Communicator?" message.



10.2.3. Connecting to the Monitor With RPComm

A connection is the hardware, software and proper settings that enable information to travel between your PC and the monitor. The hardware part of the connection is accomplished with the use of a 9-to-9 pin serial cable (Section 10.1). The software part of the connection is accomplished when RPComm is started. The proper settings must be set up within RPComm to complete the connection.

> NOTE: The Windows operating system screens shown in this section are from the Windows 98 and XP operating systems. These screens may vary slightly from your computer's screens if you are operating RPComm under other Windows operating systems.

10.2.3.1. Creating a New Connection

Follow these steps to create a new connection:

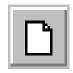
1) When in the RPComm Connection List screen (Figure 10-7), select the New Connection icon  on the tool bar. The Connection Type screen will then be displayed (Figure 10-8).

Figure 10-7. RPComm Connection List screen.

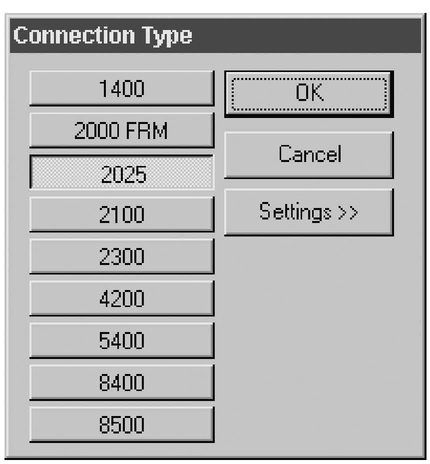


Figure 10-8. Connection Type screen.

2) When in the Connection Type screen, select the “8500” button and the “Settings” button to display the AK Protocol Setup screen (Figure 10-9).

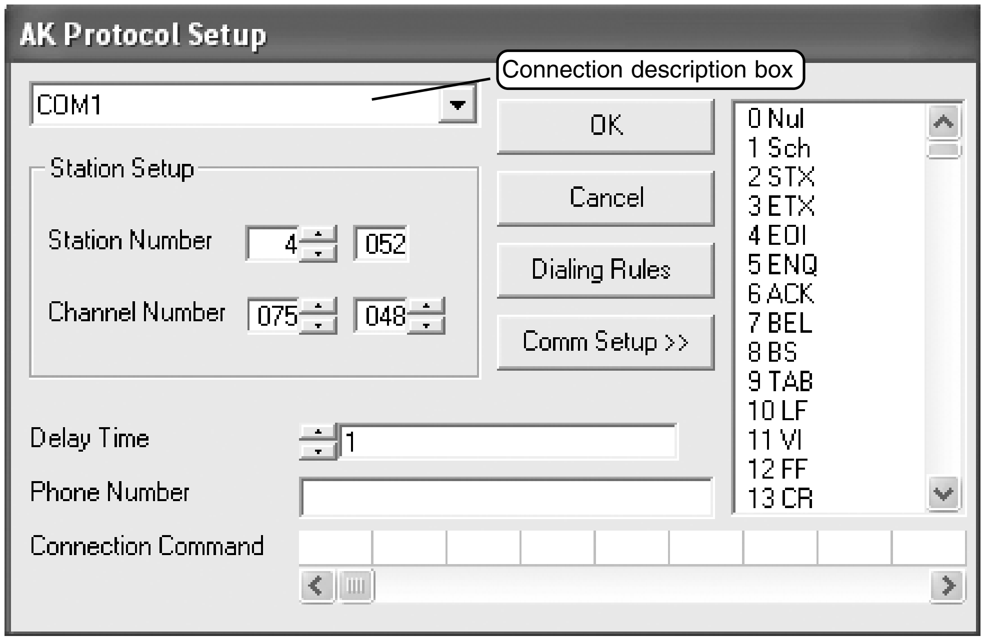


Figure 10-9. AK Protocol Setup screen.

3) For a direct connection, the “connection description box” should read “COMx,” where “x” is the serial (COM) port on your PC that the unit is connected to (Section 10.1).

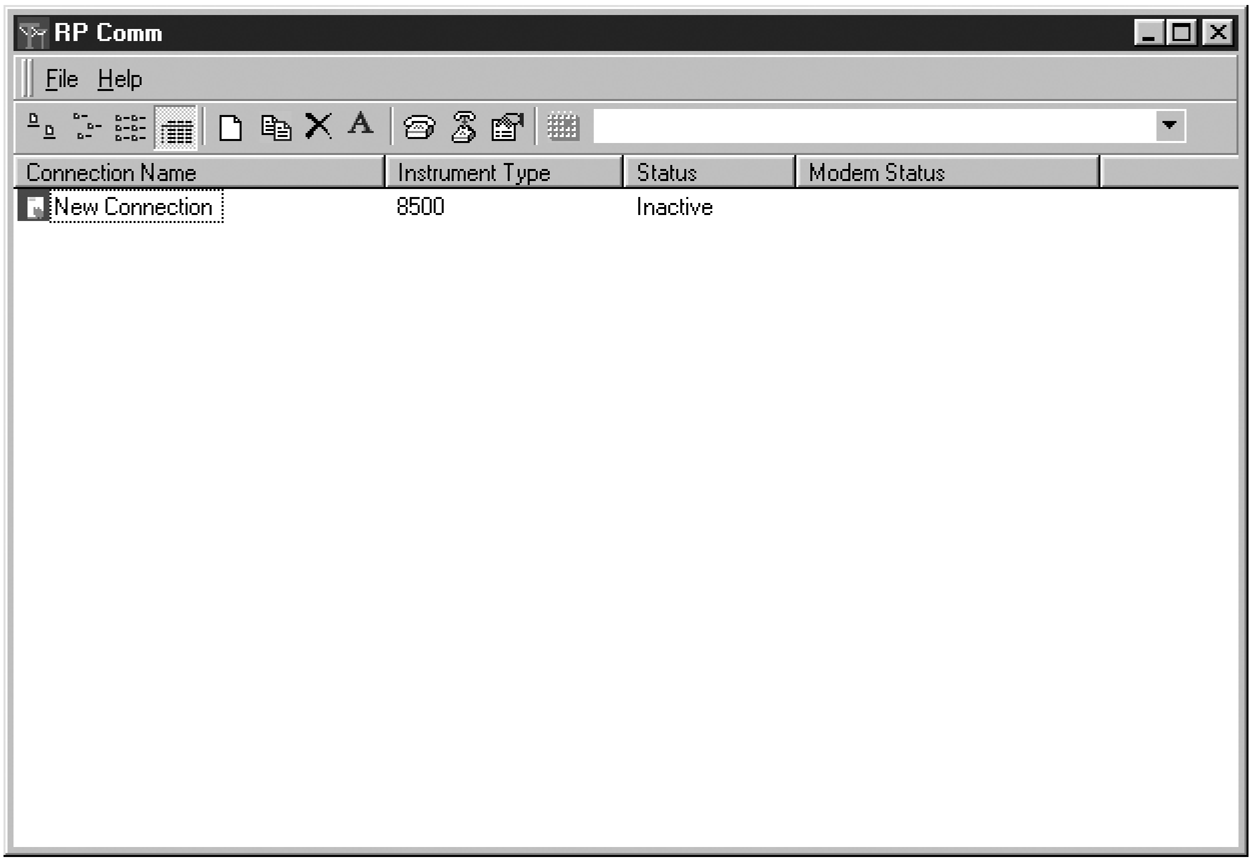
4) The Station Setup portion of the screen lists a Station Number (default = 4, 052) and Channel Number (Default = 075, 048). Do not change the default values without first contacting R&P.

5) The description boxes for Delay Time, Phone Number and Connection Command are not used for a direct connection.

6) Select “OK” when you have confirmed the proper settings.

7) **Select "OK" when in the Connection Type screen to finish the connection setup. "New Connection" will now be displayed in the Connection List screen (Figure 10-10).**

Figure 10-10. RPComm Connection List screen with a New Connection.



8) **To change the name of the "New Connection," go to Section 10.2.3.2 (Changing the New Connection Name). If not, go to step 9.**

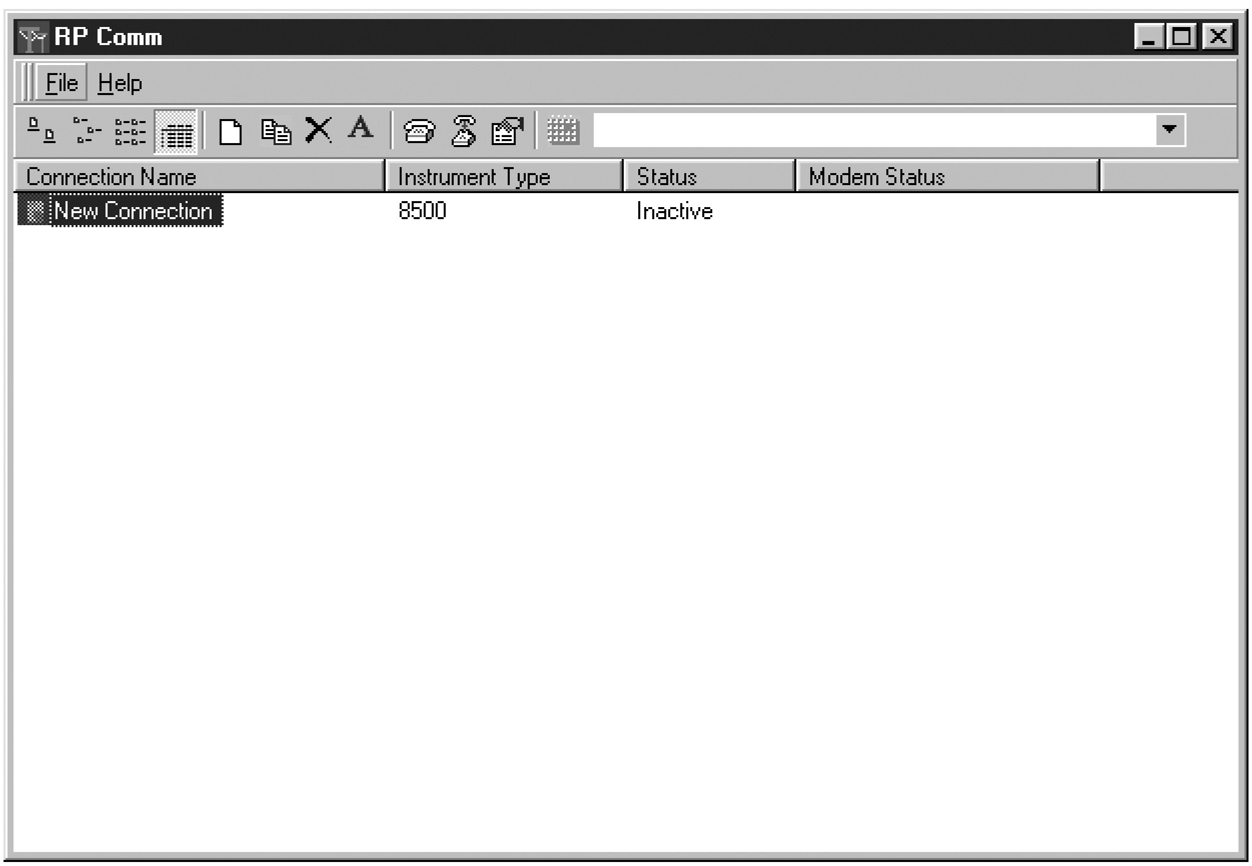
9) **If you want to create additional connections, go to Section 10.2.3.3. (Creating Multiple New Connections). If not, go to step 10.**

10) The “New Connection” should now be ready for use. If you are connecting to a Series 8500 FDMS Monitor, go to step 12. If you are connecting to a different instrument, go to step 11.

11) Because different instruments require different RS232 port settings, these values must sometimes be changed. Refer to Section 10.2.4 (Checking Connection Settings) for information on confirming or changing these settings.

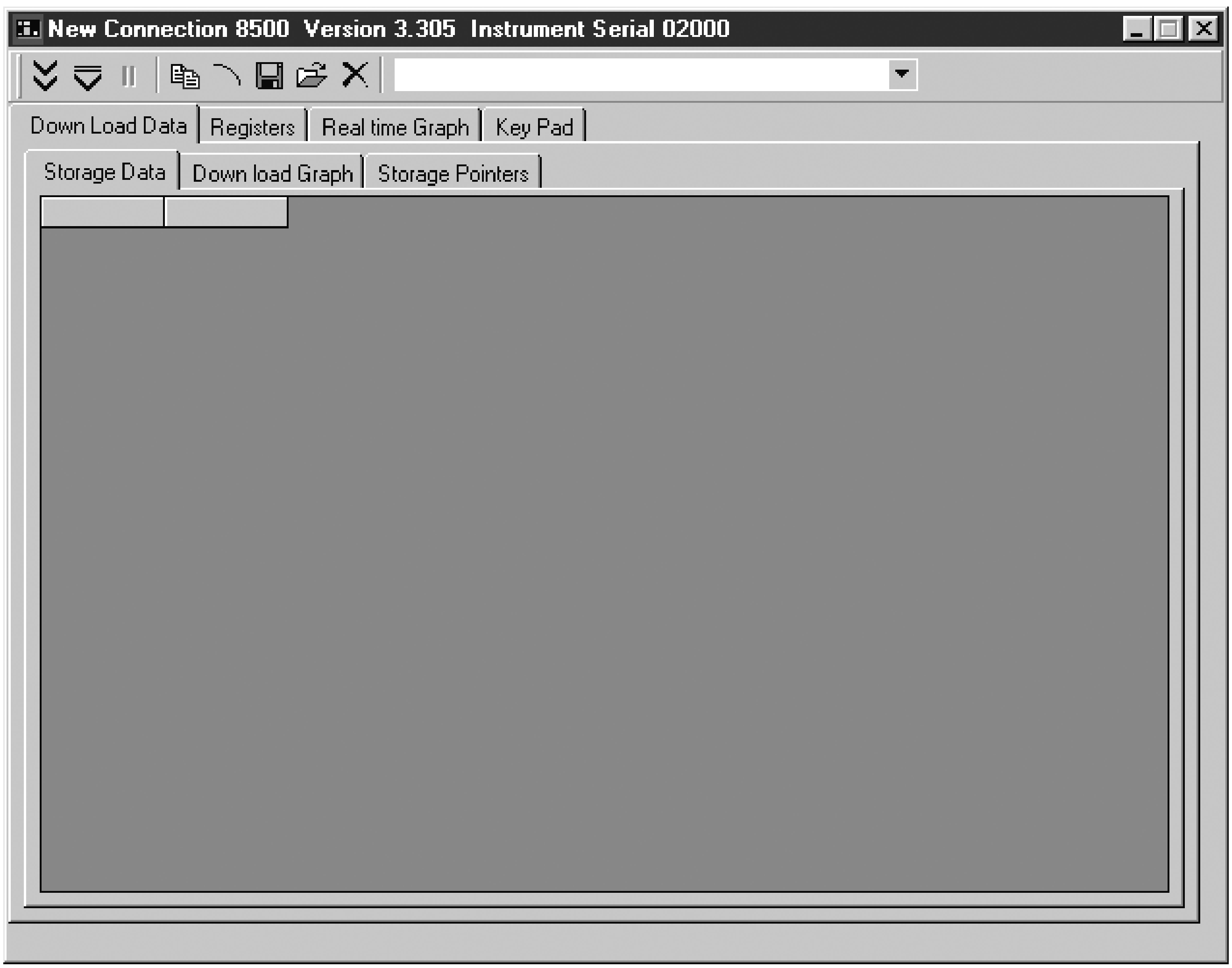
12) To connect to the monitor, click on “New Connection” to highlight the selection (Figure 10-11).

Figure 10-11. RPComm Connection List screen with New Connection highlighted.



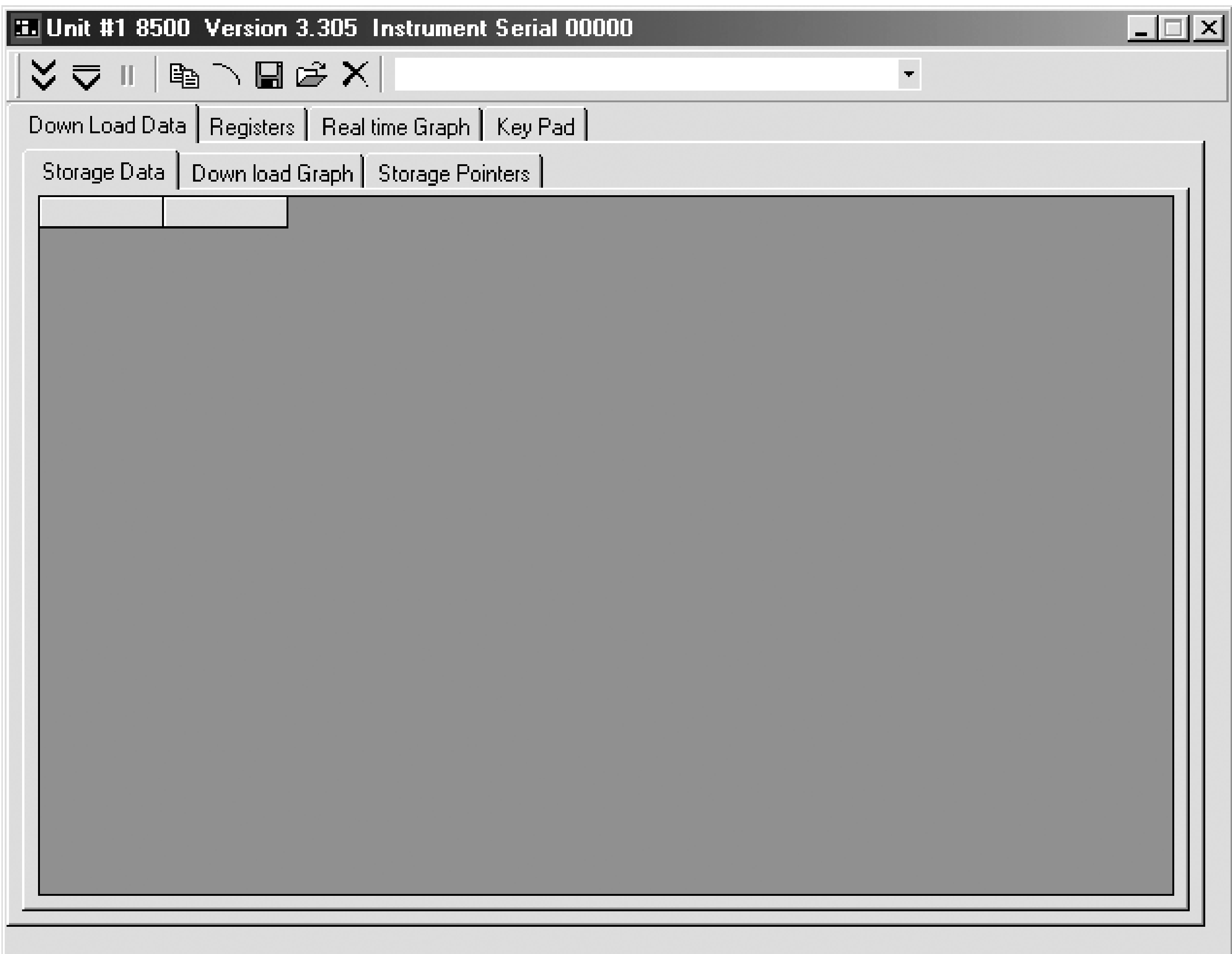
13) Select the Connection icon  on the tool bar of the Connection List screen. This will display the RPComm Download Data screen (Figure 10-12).

Figure 10-12. RPComm Download Data screen.



NOTE: If the connection is successful, the instrument's serial number will be displayed at the top of the screen (Figure 10-12). If the connection is not successful, or if there is no instrument attached, then the serial number area will be blank or will display "00000" (Figure 10-13).

Figure 10-13. RPComm Download Data screen with unsuccessful connection displayed.

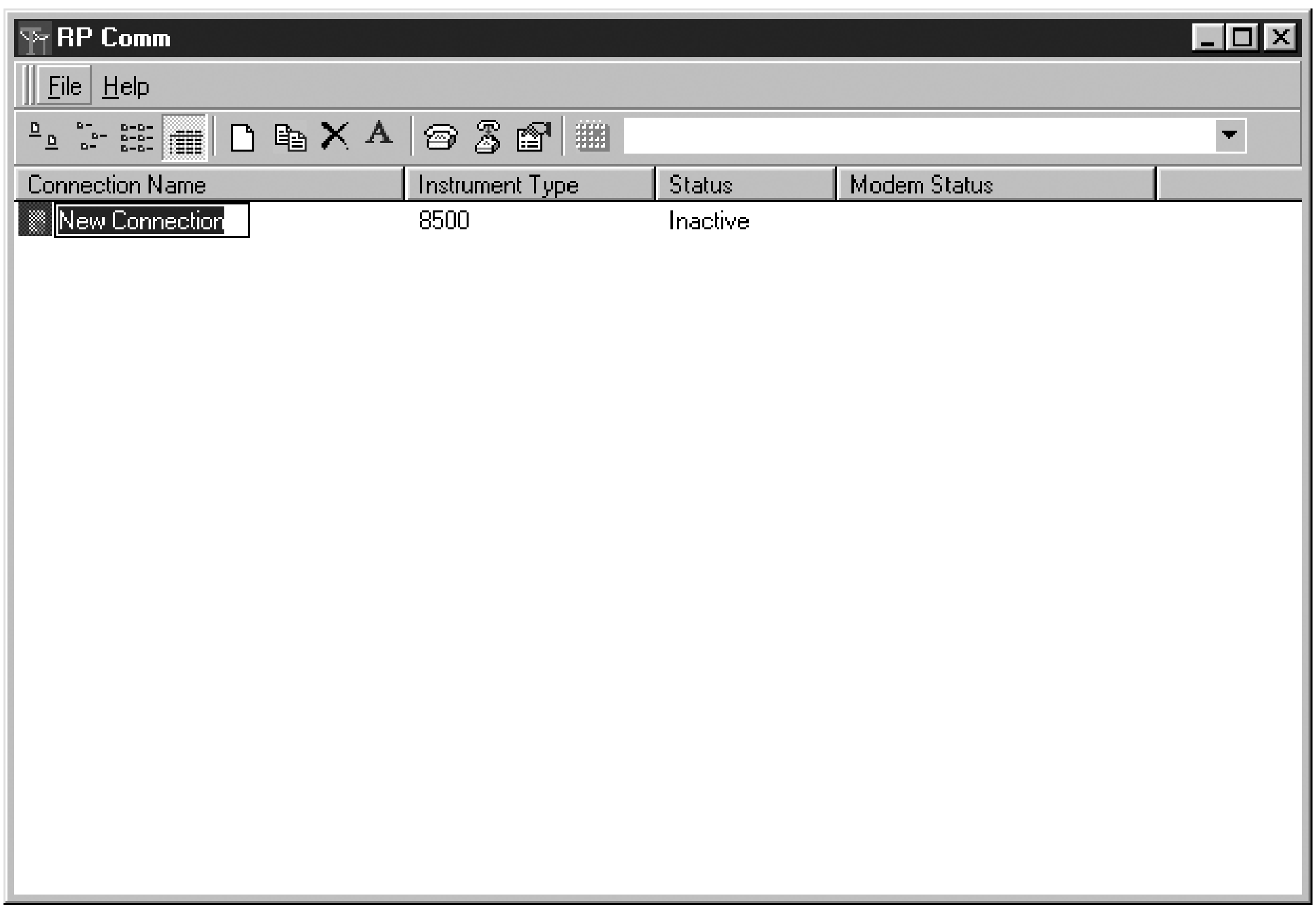


10.2.3.2. Changing the New Connection Name

Follow these steps to change the name of a new connection:

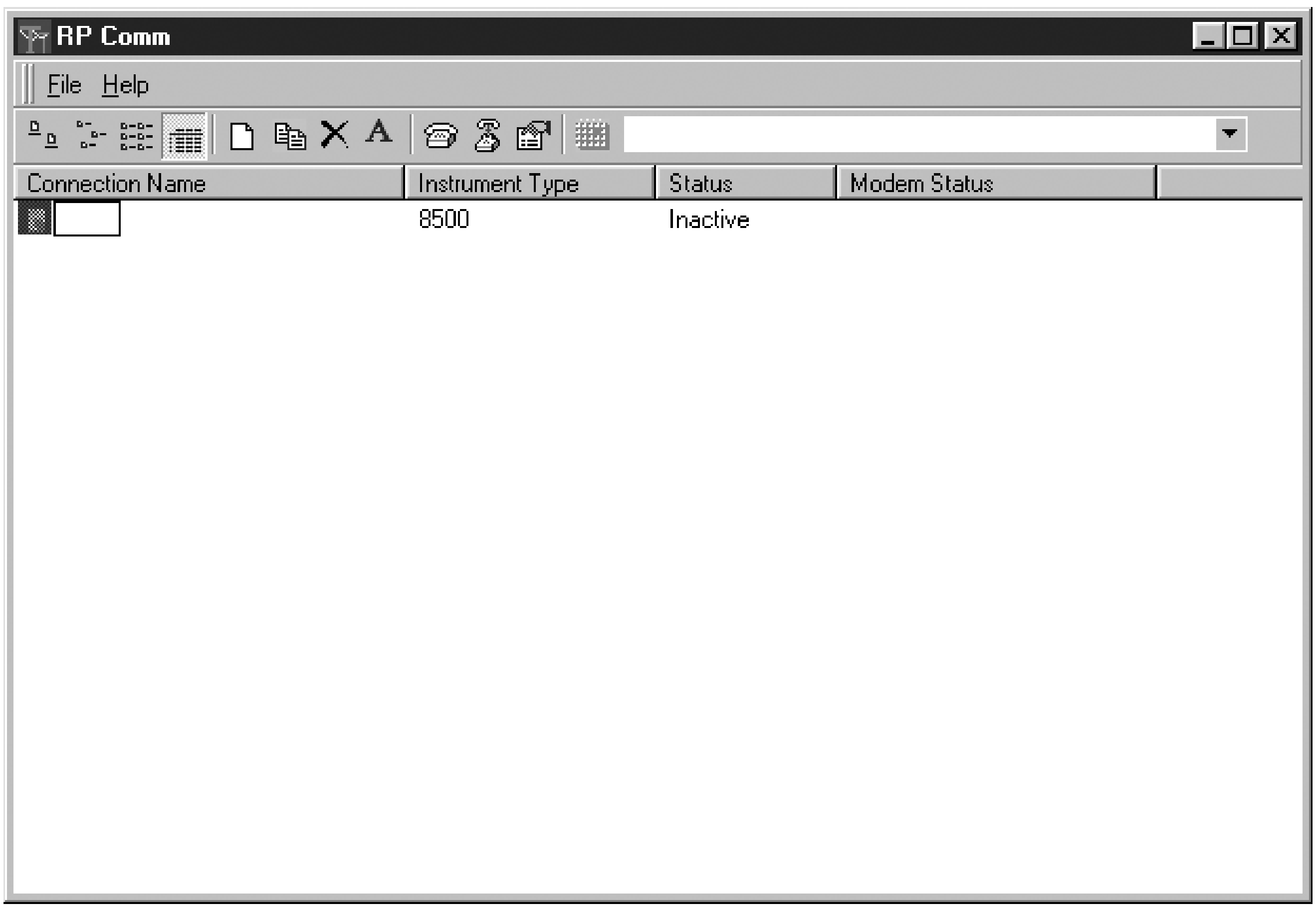
1) **Create a new connection (Section 10.2.3.1).**
2) **Click on "New Connection" to highlight the selection (Figure 10-11).**
3) **Wait 3 seconds and then click again "New Connection." The "New Connection" should now have a box around it (Figure 10-14).**

Figure 10-14. RPComm Connection List screen with New Connection highlighted and a box around it.



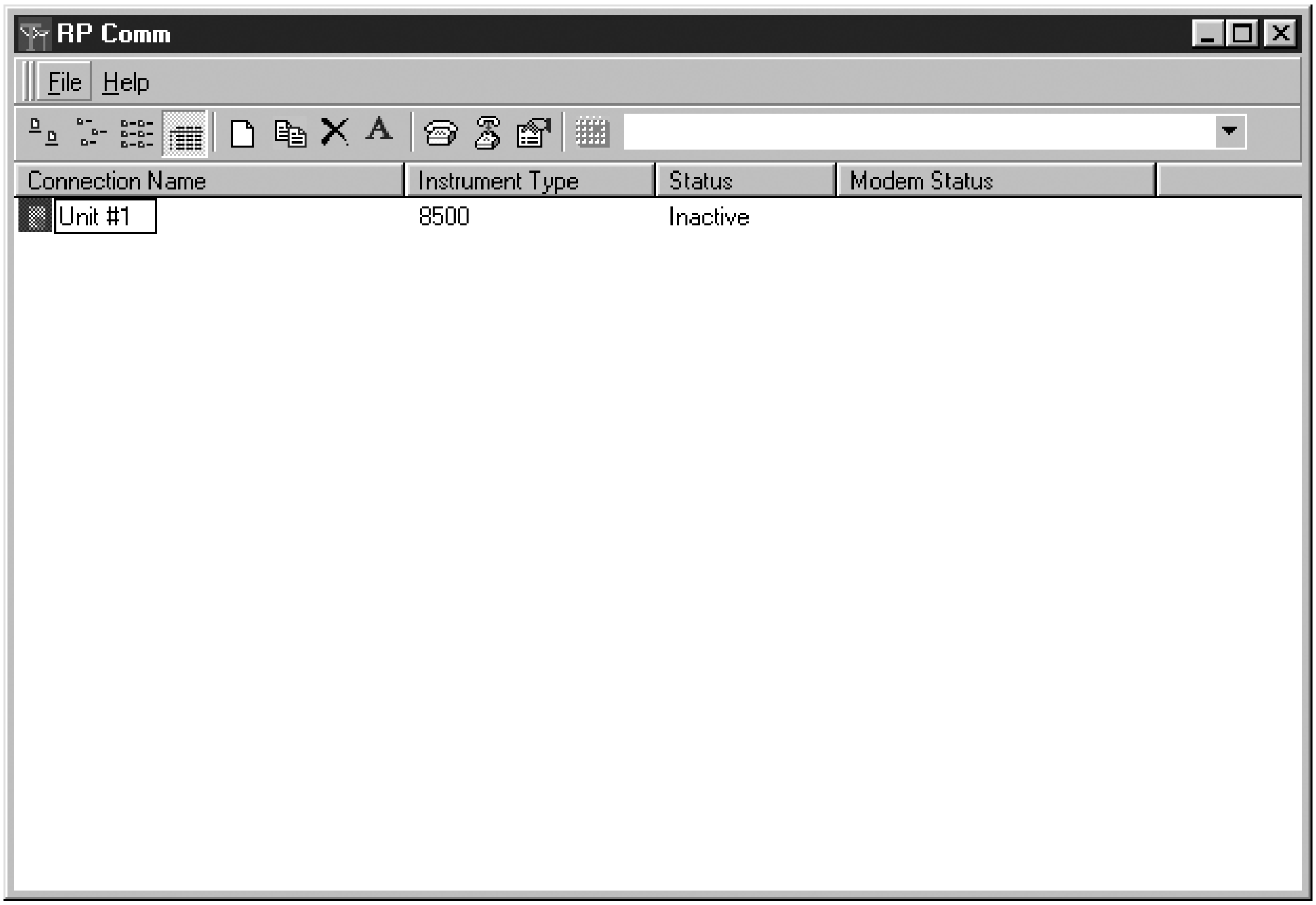
4) Press "Delete" or "Backspace" and the selection will disappear (Figure 10-15).

Figure 10-15. RPComm Connection List screen with empty space in New Connection area.



5) **Enter the desired name for the new connection (Figure 10-16).**

Figure 10-16. RPComm Connection List screen with new name for new connection.



6) **Press Enter.**

7) **To create additional connections, go to Section 10.2.3.3. (Creating Multiple New Connections). If you do not want to create additional new connections, go to step 8.**

8) **The connection should now be ready for use. If you are connecting to a Series 8500 FDMS Monitor, go to step 10. If you are connecting to a different instrument, go to step 9.**

9) Because different instruments require different RS232 port settings, these values must sometimes be changed. Refer to Section 10.2.4 (Checking Connection Settings) for information on confirming or changing these settings.

10) To connect to the monitor, click on the connection to highlight the selection.

11) Select the Connection icon  **on the tool bar of the Connection List screen. This will display the RPComm Download Data screen (Figure 10-12).**

NOTE: If the connection is successful, the instrument's serial number will be displayed at the top of the screen (Figure 10-12). If the connection is not successful, or if there is no instrument attached, then the serial number area will be blank or will display "00000" (Figure 10-13).

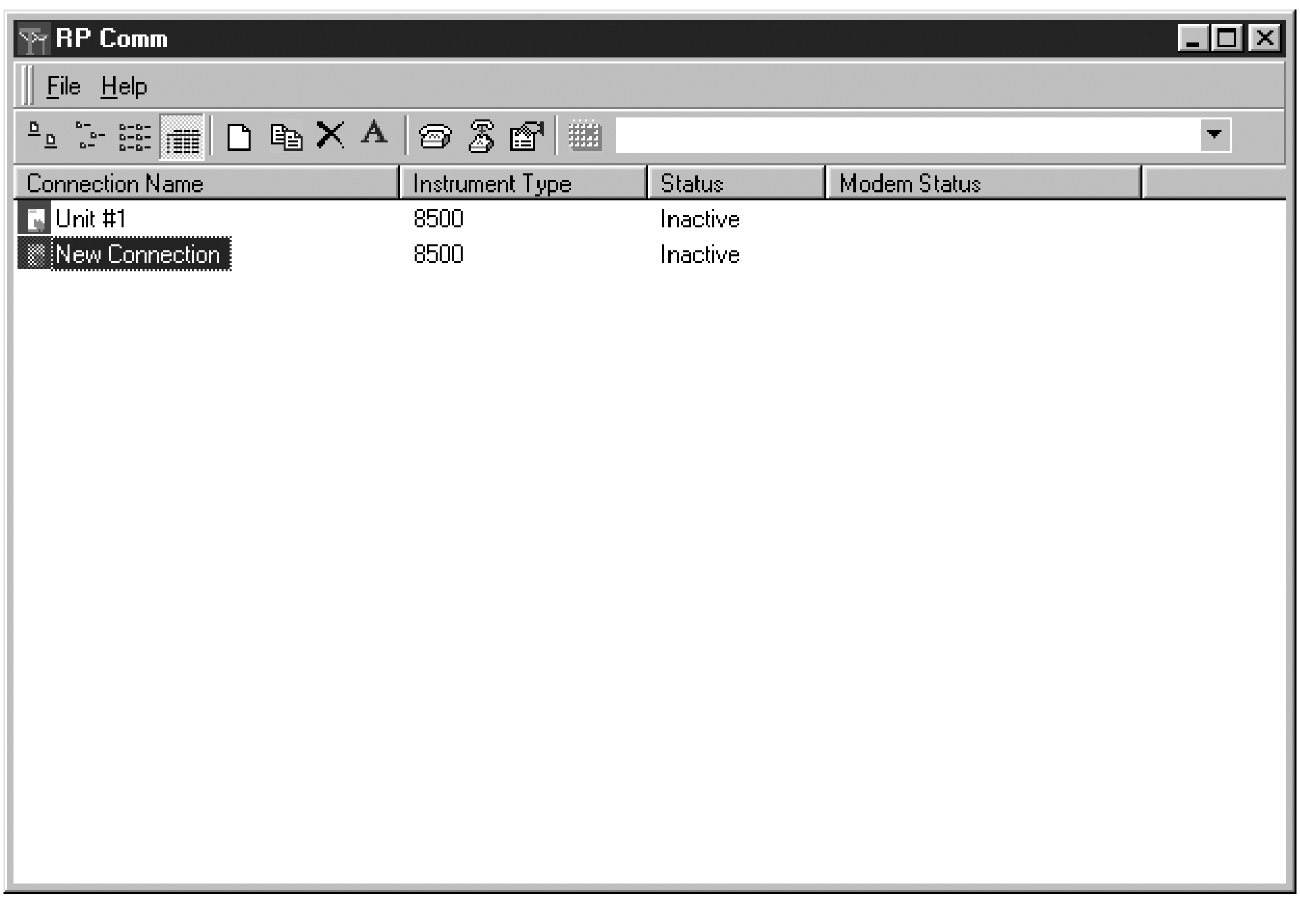
10.2.3.3. Creating Multiple New Connections

Various new connections can connect to different types of R&P instruments.

Follow these steps to create multiple new connections:

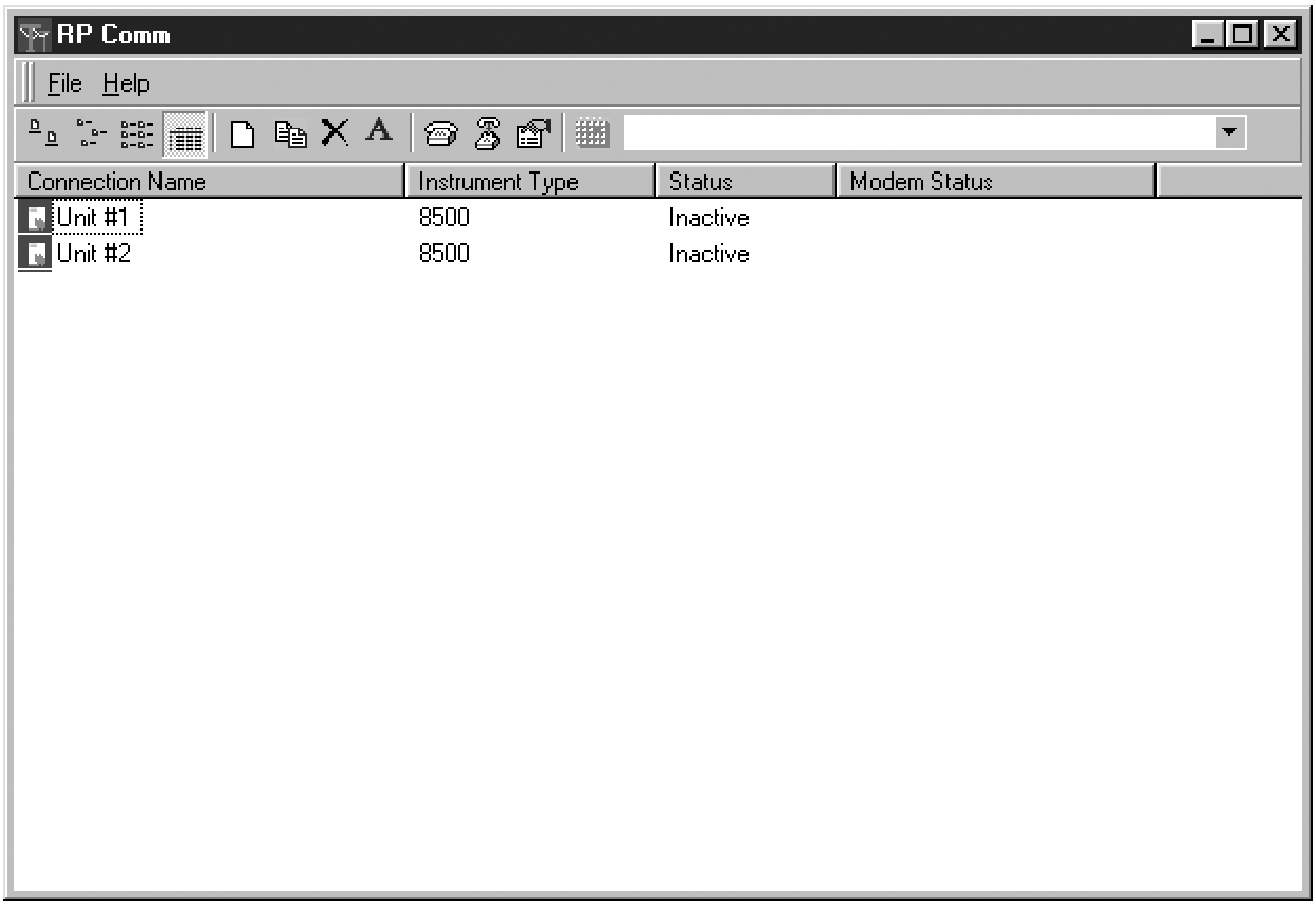
1) **If you are creating multiple new connections only to Series 8500 FDMS Monitors, go to step 2. If you are creating multiple new connections to different instruments, go to step 7.**
2) **Create a new connection (Section 10.2.3.1), and change the name of the new connection (Section 10.2.3.2).**
3) **Create another new connection (Section 10.2.3.1) (Figure 10-17).**

Figure 10-17. RPComm Connection List screen with a named connection and a new connection.



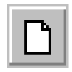
4) **Change the name of the new connection (Section 10.2.3.2) (Figure 10-18).**

Figure 10-18. RPComm Connection List screen with two named connections.



5) **Continue creating new connections and changing the name of each connection until you have reached the desired number of connections.**

6) **If you want to save all of the connections as a group, go to Section 10.2.3.4 (Saving Multiple New Connections as a Group). If you do not want to save all of the connections as a group, you have completed this procedure.**

7) When in the Connection List screen (Figure 10-7), select the New Connection icon  on the tool bar. The Connection Type screen will then be displayed (Figure 10-8).

8) When in the Connection Type screen, select the appropriate button for the type of instrument that you want to connect to, and then select the “Settings” button to display the AK Protocol Setup screen (Figure 10-9).

9) For a direct connection, the connection description box should read “COMx,” where “x” is the serial (COM) port on your PC that the unit is connected to (Section 10.1).

10) The Station Setup portion of the screen lists a Station Number (default = 4, 052) and Channel Number (Default = 075, 048). Do not change the default values without first contacting Thermo.

11) The description boxes for Delay Time, Phone Number and Connection Command are not used for a direct connection.

12) Select “OK” when you have confirmed the proper settings.

13) Select “OK” when in the Connection Type screen to finish the connection setup. “New Connection” will now be displayed in the Connection List screen (Figure 10-10).

14) Change the name of the “New Connection” (Section 10.2.3.2). After you have changed the name of the “New Connection,” go to step 15.

15) Because different instruments require different RS232 port settings, these values must sometimes be changed. Refer to Section 10.2.4 (Checking Connection Settings) for information on confirming or changing these settings. After you have confirmed or changed these settings, go to step 16.

16) If you want to create another new connection, go to step 1. If you do not want to create another new connection, go to step 17.

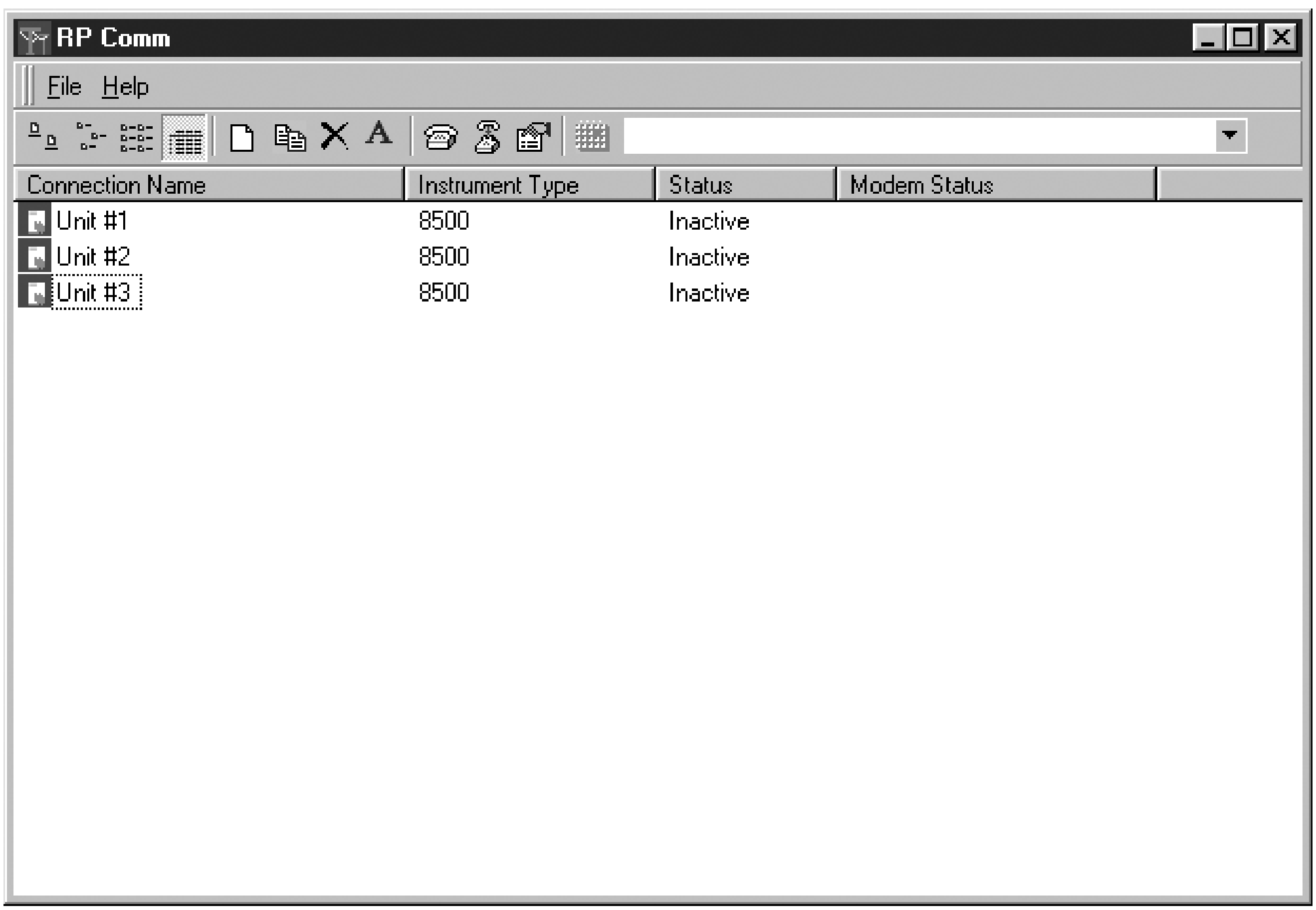
17) If you want to save all of the connections as a group, go to Section 10.2.3.4 (Saving Multiple New Connections as a Group). If you do not want to save all of the connections as a group, you have completed this procedure.

10.2.3.4. Saving Multiple New Connections as a Group

Follow these steps to save multiple new connections as a group:

1) **Create multiple new connections (Section 10.2.3.3).**
2) **Ensure that the RPComm Connection List screen is displayed with the multiple connections (Figure 10-19).**

Figure 10-19. RPComm Connection List screen with multiple connections displayed.



3) Select the “File” pull down menu and choose “Save Group” (Figure 10-20). This will display the Save Connection Group screen (Figure 10-21).

Figure 10-20. RPComm Connection List screen with “File” pull down menu displayed.

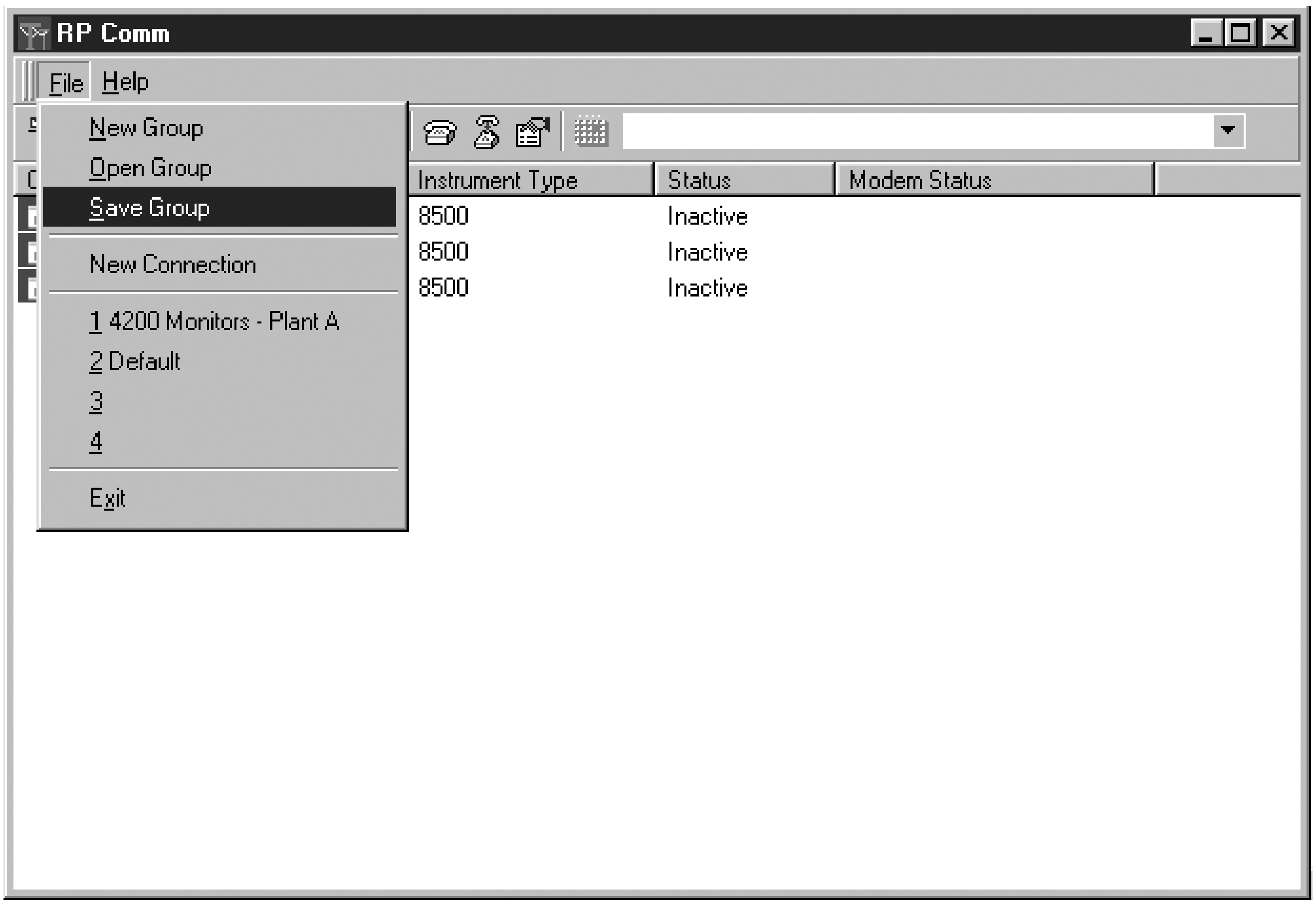
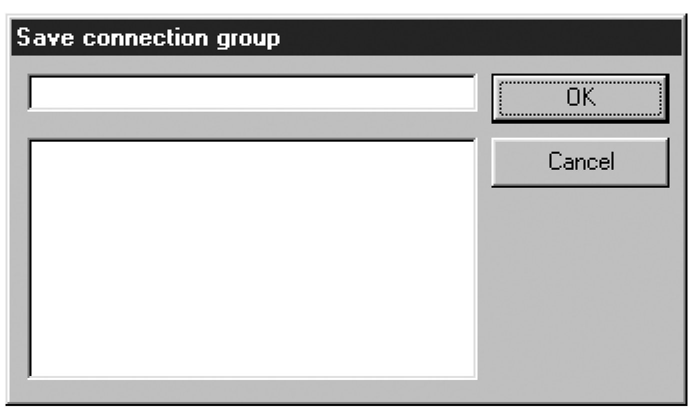
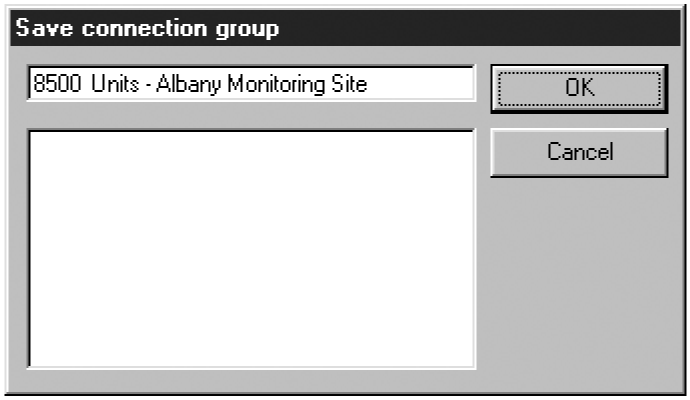


Figure 10-21. Save Connection Group screen.



4) When in the Save Connection Group screen, type a name for the group of new connections into the top white box (Figure 10-22).

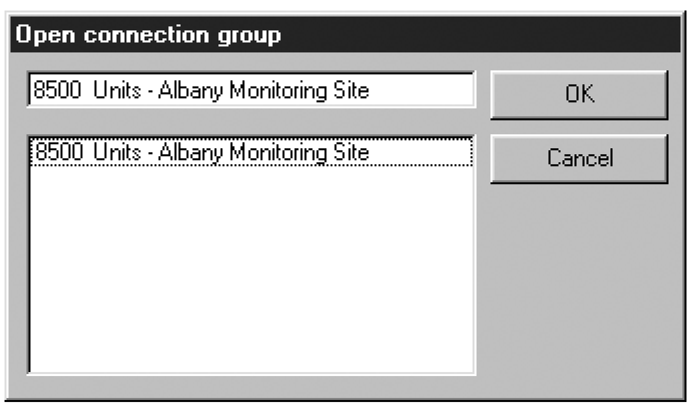
Figure 10-22. Save Connection Group screen with group name entered into the top white box.



5) Select "OK."

6) When in the RPComm Connection List screen (Figure 10-7), select the "File" pull down menu and choose "Open Group" (Figure 10-20). This will display the Open Connection Group screen (Figure 10-23).

Figure 10-23. Open Connection Group screen.



7) Verify that the group name that you entered in step 4 is correct.

8) Select "Cancel."

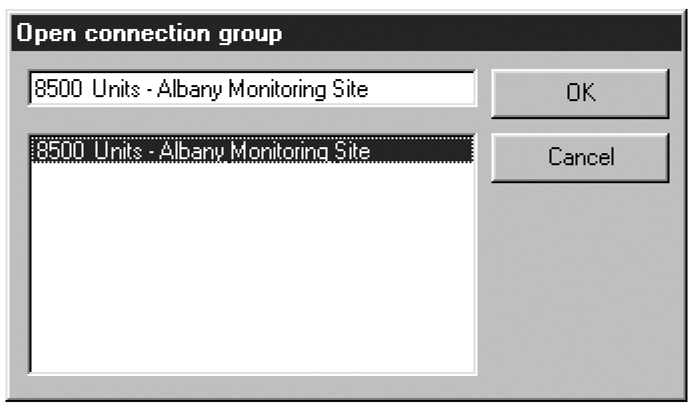
10.2.3.5. Opening a Saved Group

Follow these steps to open a saved group:

1) **When in the RPComm Connection List screen (Figure 10-7), select the “File” pull down menu and choose “Open Group” (Figure 10-20). This will display the Open Group screen (Figure 10-23).**

2) **Place your cursor on the saved group name and click once with your mouse. The saved group name should now be highlighted (Figure 10-24).**

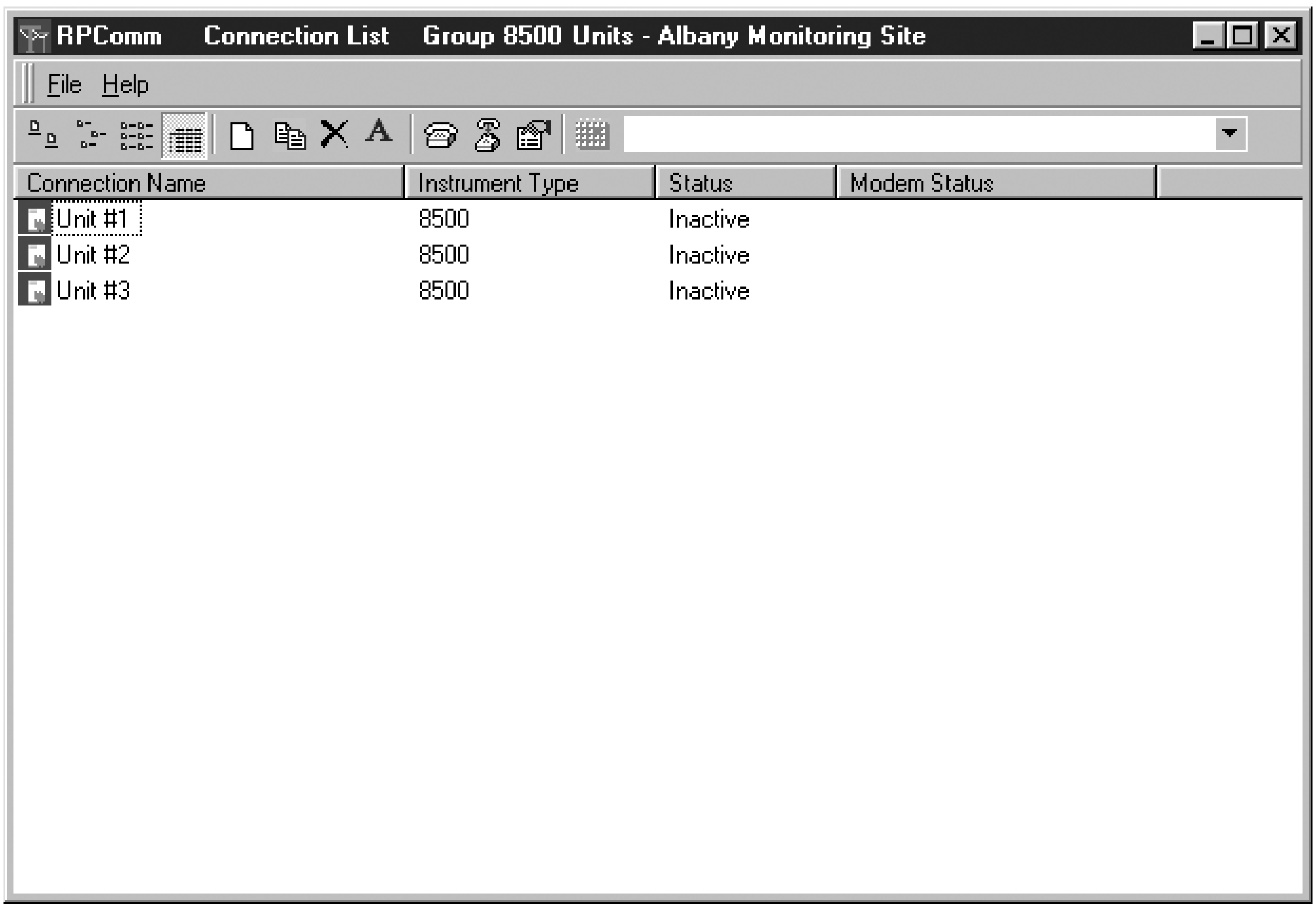
Figure 10-24. Open Connection Group screen with group name high-lighted.



3) **Select “OK.”**

4) The connections that you saved under the saved group name should now appear in the RPComm Connection List screen, and the name of the saved group should appear at the top of the screen (Figure 10-25).

Figure 10-25. RPComm Connection List screen with the name of the saved group at the top of the screen.



10.2.4. CHECKING CONNECTION SETTINGS

Because different instruments require different RS232 port settings, these values must sometimes be changed. You also may want to confirm the settings before beginning to download data from the Series 8500 FDMS Monitor.

Follow these steps to check (or change) the RS232 port settings in RPComm:

1) **When in the RPComm Connection List screen (Figure 10-7), select the "Display Connection Properties" button  . The AK Protocol Setup screen will display (Figure 10-26).**

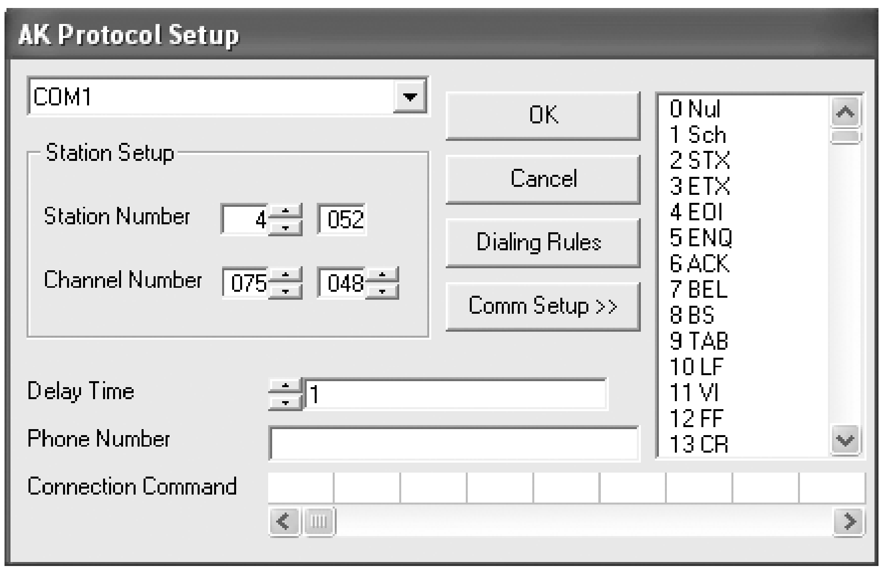


Figure 10-26. AK Protocol Setup screen.

2) **When in the AK Protocols Setup screen, select the "Comm Setup" button. The "Properties" screen with the telephone setup information will display (Figure 10-27) in front of the Comm Setup screen.**

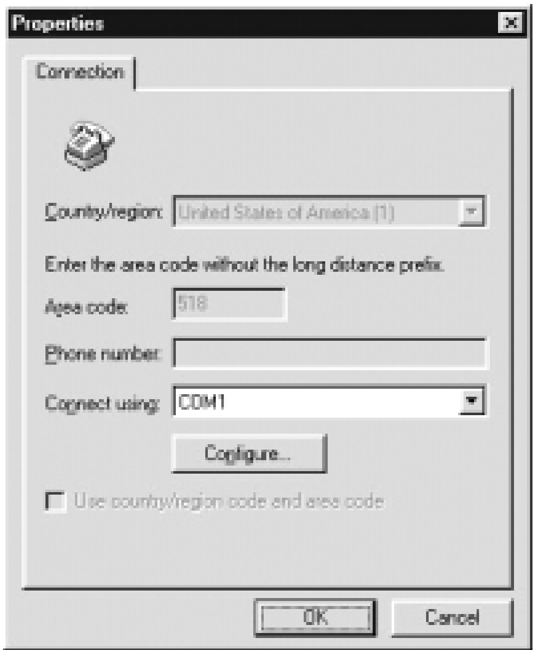


Figure 10-27. Properties screen with telephone setup information.

3) **Select the "Configure..." button. The Properties screen with COM setup information will display (Figure 10-28).**

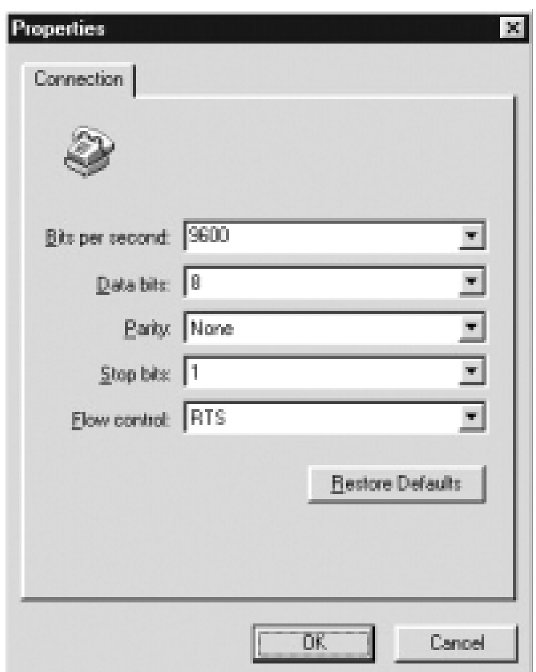


Figure 10-28. Properties screen with COM setup information.

4) When in the Properties screen with COM setup information, check the settings. For the Series 8500 FDMS Monitor, the settings should be:

Baud rate = 9600
Data bits = 8
Parity = None
Stop bits = 1
Flow control = RTS.

5) Change the values to match your instrument, if necessary.

NOTE: To return the settings to their default values, select the “Restore Defaults” button.

6) When the settings are accurate, select the “OK” button in the Properties screen with COM setup information.

7) When in the Properties screen with telephone setup information, select “OK.”

8) When in the AK Protocol Setup screen, select “OK.” The RPComm Connection List screen will now display.

10.2.5. Downloading Data

Thermo instruments keep track of which records have been downloaded by using "storage pointers." These storage pointers indicate the most recently retrieved data record, and serve as the starting point for future downloads. Every time RPComm downloads data records from the Series 8500 FDMS Monitor, the unit's storage pointer is moved to the last data record that was downloaded.

The user can download all the data that are stored in the unit's internal data logger beginning at the storage pointer. The storage pointer is a "place marker" in the unit's data logger. It indicates to the RPComm program where the data download should begin. After the data have been downloaded, the unit sets the storage pointer to the end of the internal data storage buffer, so that the next time data are downloaded, only new data records are transmitted. However, if the user wants to download specific records (for example, from a particular date), they can change the position of the storage pointer within the data storage buffer (Section 10.2.5.1). Also, you can move the storage pointer to re-download data that has been lost from your PC, or to skip forward to download more recent data records.

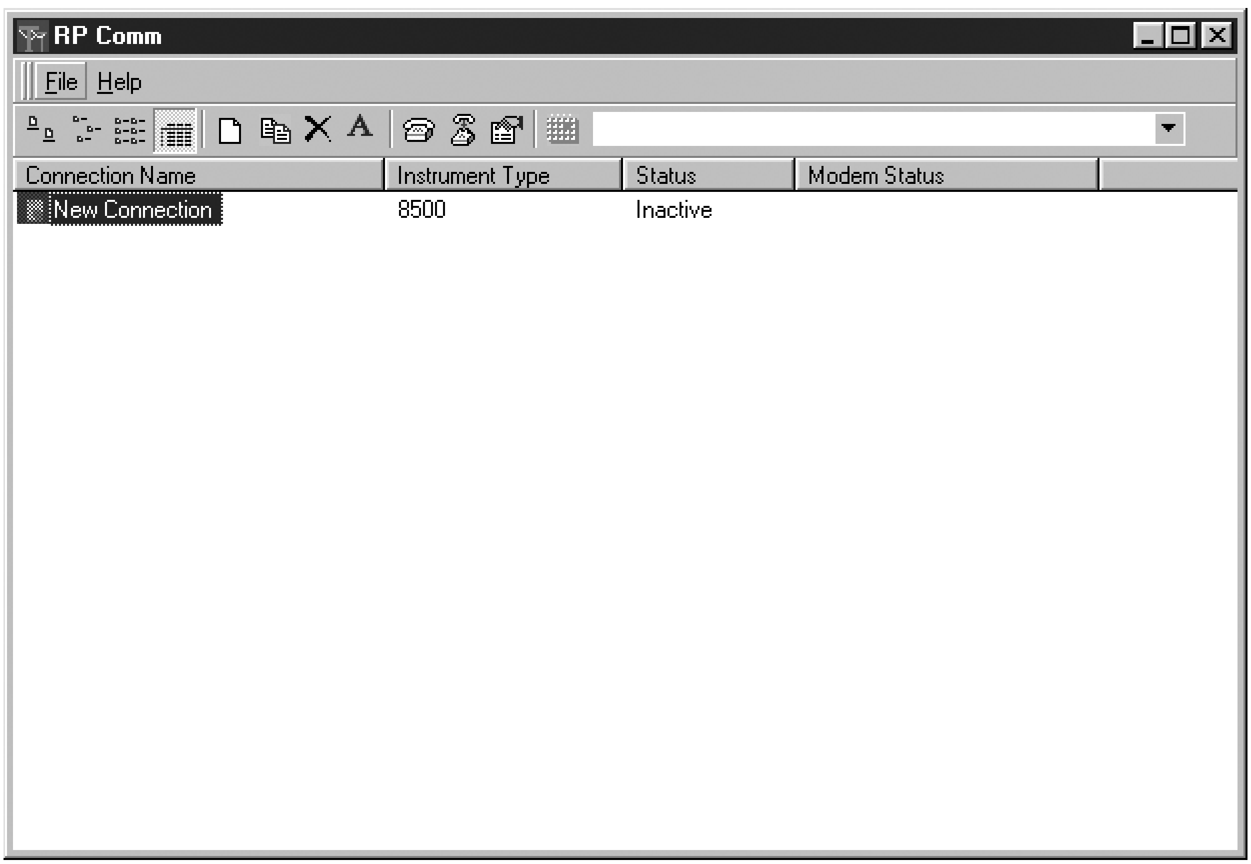
> NOTE: The Windows operating system screens shown in this section are from the Windows 98 and XP operating systems. These screens may vary slightly from your computer's screens if you are operating RPComm under other Windows operating systems.

10.2.5.1. Setting the Storage Pointer Position

Follow these steps to set the storage pointer position:

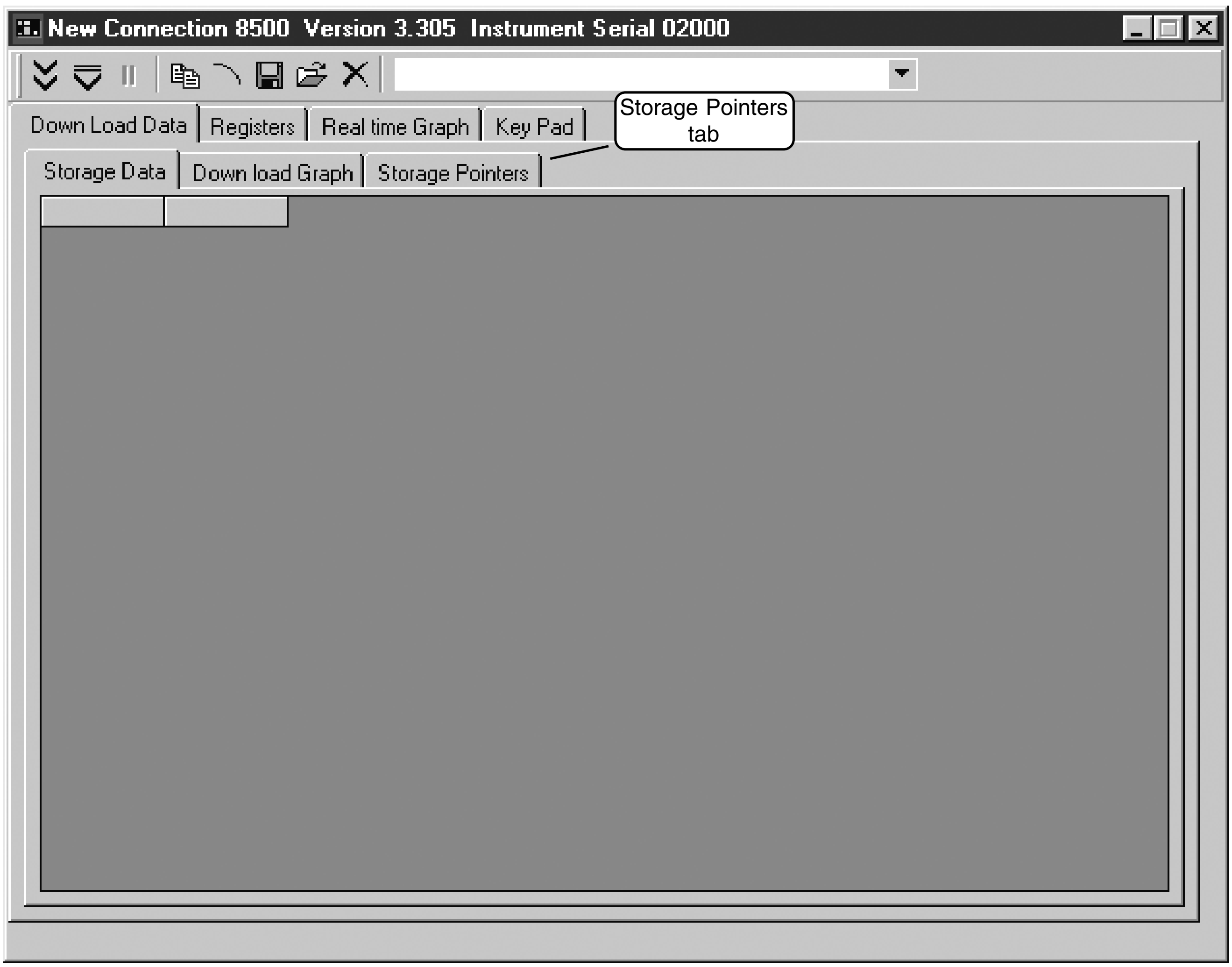
1) **When in the RPComm Connection List screen (Figure 10-7), ensure that a new connection or other connection name is selected (Figure 10-29).**

Figure 10-29. RPComm Connection List screen with a new connection highlighted.



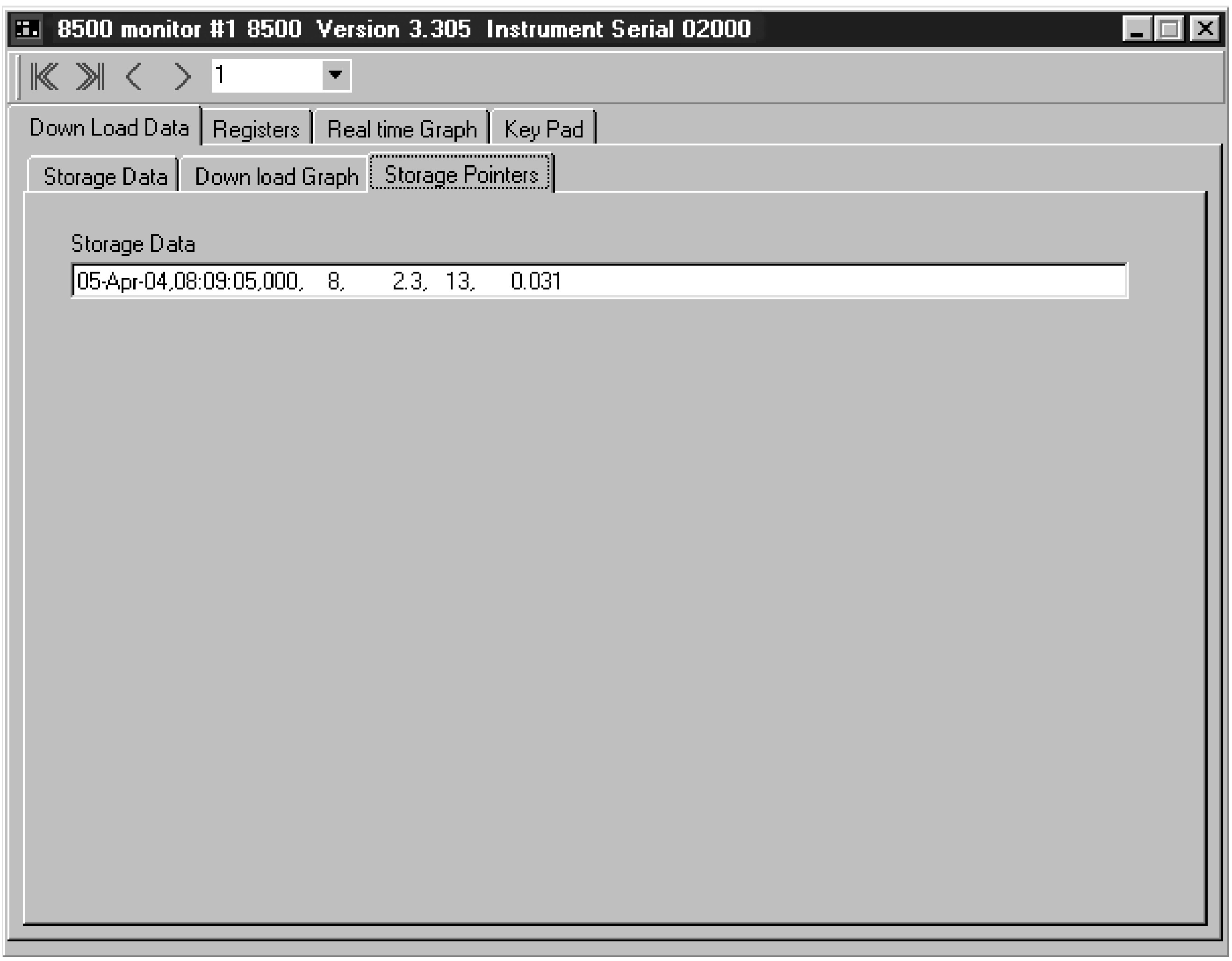
2) Select the Connection icon on the tool bar (Figure 10-29). The RPComm Download Data screen will display (Figure 10-30).

Figure 10-30. RPComm Download Data screen.



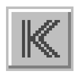
3) **When in the Download Data screen, select the Storage Pointers tab (Figure 10-30). The Storage Pointers screen will display (Figure 10-31).**

Figure 10-31. Storage Pointers screen.

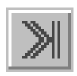


4) When in the Storage Pointers screen, select the appropriate control buttons to move the storage pointer. Refer to Figure 10-32 for a complete description of the control buttons on the Storage Pointers screen.

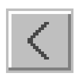
Figure 10-32. Control buttons on the Storage Pointers screen.



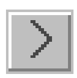
Moves the storage pointer to the first record in the buffer. The displayed position of the storage pointer will change, unless the storage pointer was already at the beginning of the buffer.



Moves the storage pointer to the last record in the buffer. The displayed position of the storage pointer will change, unless the storage pointer was already at the end of the buffer.



Moves the storage pointer back “x” number of records, where “x” is defined in the Change Record Step box



Moves the storage pointer forward “x” number of records, where “x” is defined in the Change Record Step box.

Change Record Step box. The step size can be 1, 5, 10, 100 or 1000.

5) After you have set the storage pointers position, go to Section 10.2.5.2 for information on downloading the data records.

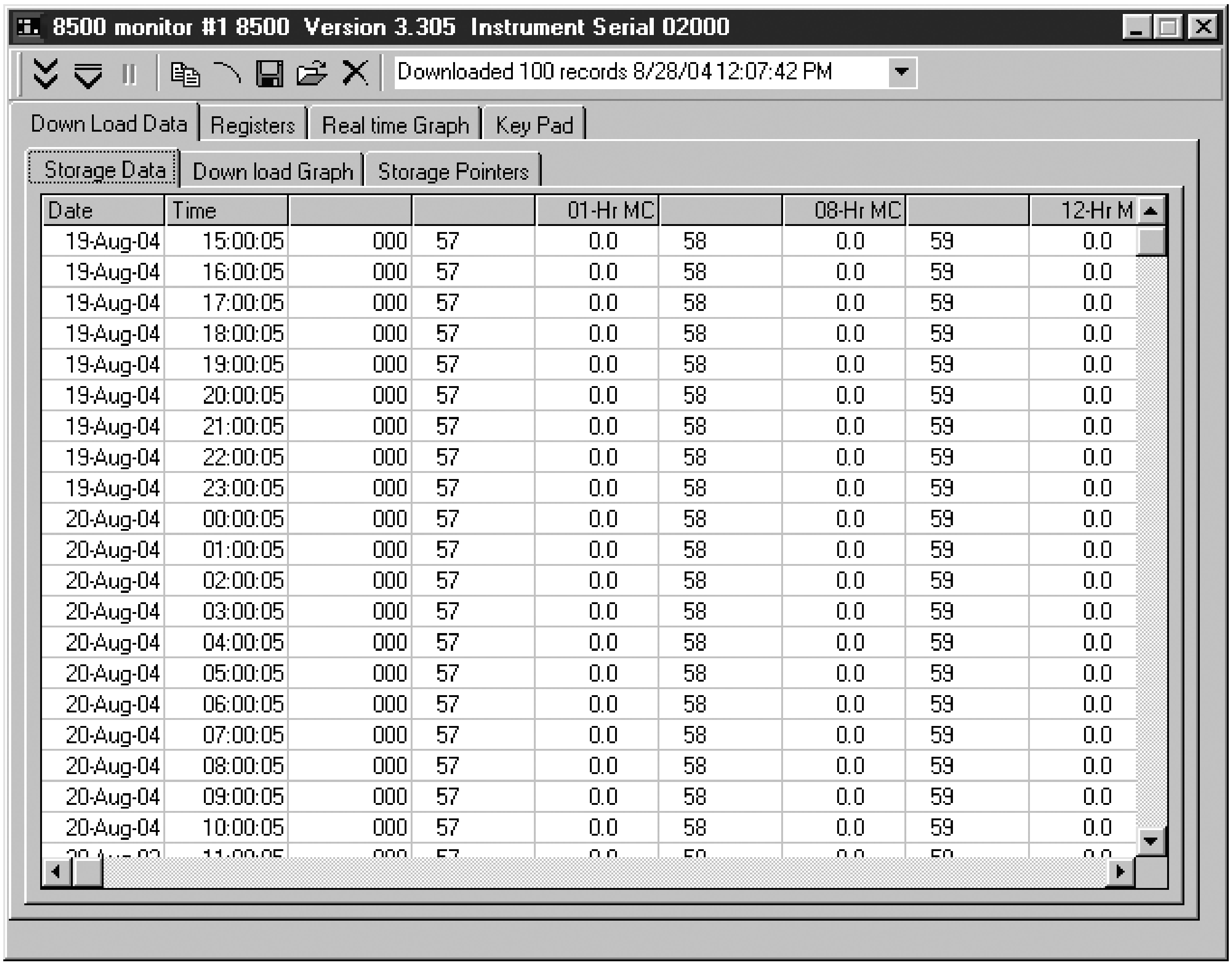
10.2.5.2. Downloading Data From a Storage Buffer

Follow these steps to download data with RPComm from one of the data storage buffers:

1) **Ensure that the storage pointer(s) is in the correct position (Section 10.2.5.1).**
2) **When in the RPComm Connection List screen, ensure that a new connection or other connection name is selected (Figure 10-29).**
3) **Select the Connection icon  on the tool bar (Figure 10-29).**

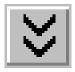
   The RPComm Download Data screen will display (Figure 10-30).
4) **When in the RPComm Download Data screen, select the appropriate control button to initiate the data downloading process. After the data downloading procedure is complete, the Download Data screen will display with the data records that were downloaded (Figure 10-33). Refer to Figure 10-34 for a complete description of the control buttons on the RPComm Download Data screen.**

Figure 10-33. Downloaded storage data.

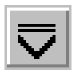


Date	Time			01-Hr MC		08-Hr MC		12-Hr M
19-Aug-04	15:00:05	000	57	0.0	58	0.0	59	0.0
19-Aug-04	16:00:05	000	57	0.0	58	0.0	59	0.0
19-Aug-04	17:00:05	000	57	0.0	58	0.0	59	0.0
19-Aug-04	18:00:05	000	57	0.0	58	0.0	59	0.0
19-Aug-04	19:00:05	000	57	0.0	58	0.0	59	0.0
19-Aug-04	20:00:05	000	57	0.0	58	0.0	59	0.0
19-Aug-04	21:00:05	000	57	0.0	58	0.0	59	0.0
19-Aug-04	22:00:05	000	57	0.0	58	0.0	59	0.0
19-Aug-04	23:00:05	000	57	0.0	58	0.0	59	0.0
20-Aug-04	00:00:05	000	57	0.0	58	0.0	59	0.0
20-Aug-04	01:00:05	000	57	0.0	58	0.0	59	0.0
20-Aug-04	02:00:05	000	57	0.0	58	0.0	59	0.0
20-Aug-04	03:00:05	000	57	0.0	58	0.0	59	0.0
20-Aug-04	04:00:05	000	57	0.0	58	0.0	59	0.0
20-Aug-04	05:00:05	000	57	0.0	58	0.0	59	0.0
20-Aug-04	06:00:05	000	57	0.0	58	0.0	59	0.0
20-Aug-04	07:00:05	000	57	0.0	58	0.0	59	0.0
20-Aug-04	08:00:05	000	57	0.0	58	0.0	59	0.0
20-Aug-04	09:00:05	000	57	0.0	58	0.0	59	0.0
20-Aug-04	10:00:05	000	57	0.0	58	0.0	59	0.0

Figure 10-34. Control buttons on the RPComm Download Data screen.



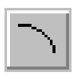
Downloads all stored data in the data buffer, starting at the first data record. After the data are downloaded, the storage pointer will move to the end of the data storage buffer. When the data have been downloaded, the data will be displayed in the Download Data screen.



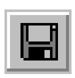
Downloads data from the current storage pointer position to the end of the data buffer. After the data are downloaded, the storage pointer will move to the end of the data storage buffer.

Aborts the download. This action will set the storage pointer to the record location where the download was aborted.

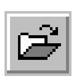
Copies the selected data to the Windows clipboard. The data can then be imported and used in other programs.



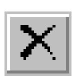
Sends the selected data to the Download Graph screen.



Stores the data to a file. The file is saved in a comma-delimited ASCII format.



Opens a data file that has been previously saved to disk for display or graphing.



Clears the data currently being displayed.

When the download has been successfully completed, a message will appear in the Dialog box indicating how many records were downloaded.

10.2.6. Manipulating Downloaded Data

Once data has been downloaded, it can be manipulated for different uses. All data manipulation procedures listed in this section can be performed within RPComm without being connected to the unit.

> NOTE: The Windows operating system screens shown in this section are from the Windows 98 and XP operating systems. These screens may vary slightly from your computer's screens if you are operating RPComm under other Windows operating systems.

10.2.6.1. Copying Data to the Clipboard

Once data have been downloaded and displayed in RPComm, a selection of the data can be copied to the Windows clipboard for use in other applications.

Follow these steps to copy data to the Windows clipboard:

1) **Ensure that the storage pointer (s) is in the correct position (Section 10.2.5.1).**
2) **Download data from the storage buffers that you want to display (Section 10.2.5.2).**
3) **When in the downloaded data screen with the storage data displayed, place your cursor on the data cell where you want to begin the selection. Press and hold down the left mouse button and drag the cursor until all the desired data is selected.**
4) **An alternate way to select data is to place your cursor on the column heading where you wish to begin the selection. Press and hold down the left mouse button and drag the cursor across the columns until all the desired data are selected. This will choose all the data in the selected columns.**
5) **When you have selected the appropriate data (step 3) or data columns (step 4), select the Copy icon**  **on the tool bar (Figures 10-33 and 10-34). This will copy the selected data to the Windows clipboard. The data can then be pasted into another application.**

   NOTE: Column heading information will be included with these data, even if the entire column was not selected.

10.2.6.2. Graphing Downloaded Data

Follow these steps to graph downloaded data:

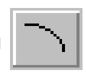
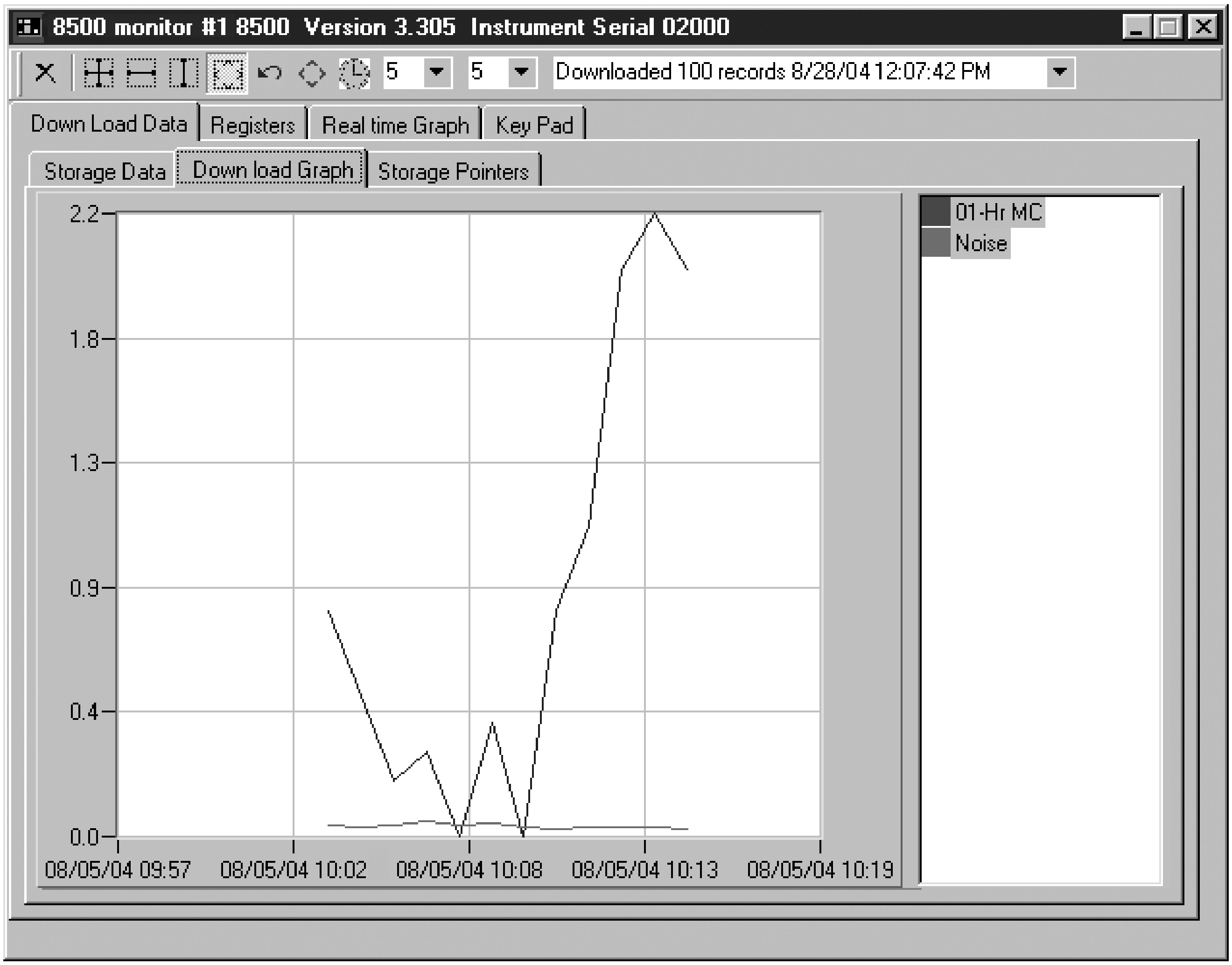
1) **When in the RPComm Download Data screen with storage data displayed (Figure 10-33), place your cursor on the data cell where you want to begin the selection. Press and hold down the left mouse button and drag the cursor until all the desired data is selected.**
2) **An alternate way to select data is to place your cursor on the column heading where you wish to begin the selection. Press and hold down the left mouse button and drag the cursor across the columns until all the desired data are selected. This will choose all the data in the selected columns.**
3) **When you have selected the appropriate data (step 1) or data columns (step 2), select the Graph icon  on the tool bar (Figures 10-33 and 10-34). This will send the selected data to the Download Graph tab.**
4) **When in the RPComm Download Data screen (Figure 10-33), select the Download Graph tab. The data that were selected should now be graphed and will appear in the Download Graph screen (Figure 10-35). The color key on the right portion of the Download Graph screen shows the variables being graphed and their corresponding colors.**

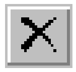
Figure 10-35. Download Graph screen.



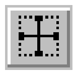
5) To display only one of the selected sets of data, choose the desired data set from the color key. To display all selected sets of data again, choose each data set from the color key while holding down the “Shift” key on your PC’s keyboard.

6) Refer to Figure 10-36 for a complete description of the control buttons on the Download Graph screen.

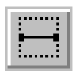
Figure 10-36. Control buttons on the Download Graph screen.



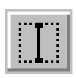
Clears all data listed on the right-hand side of the Download Graph screen. This includes the data being displayed.



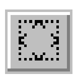
Decreases the scale of the x- and y-axes concurrently. With this icon selected, press and hold the left mouse button and make a box around an area (inside the graph) that you want to zoom into. Once the box is finished, release the mouse button. The graph will be resized according to the box dimensions.



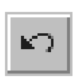
Decreases the scale of the x-axis. With this icon selected, press and hold the left mouse button at the beginning of the area that you want to zoom into. Drag the cursor horizontally to the end of the zoom area and release the mouse button. The graph will be resized according to the new x-axis dimensions.



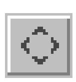
Decreases the scale of the y-axis. With this icon selected, press and hold the left mouse button at the beginning of the area that you want to zoom into. Drag the cursor vertically to the end of the zoom area and release the mouse button. The graph will be resized according to the new y-axis dimensions.



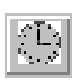
Enables panning. Panning allows the user to move the graph area so that a different section of the x- or y-axis will be displayed without affecting the scale of either axis. With this icon selected, place the mouse cursor somewhere within the graph area and hold down the left mouse button. Move the mouse to display the desired section of the graph.



Selecting this icon will undo the last zoom or panning step.



Rescales the x- and y-axes so that all the graphs for the selected data are displayed.

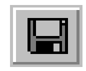


Toggles between the two possible x-axis scales: date and time, and time only. This does not affect the way the data are displayed on the graph.

These two boxes define the number of axis divisions on the graph. The left box refers to the x axis and the right box refers to the y axis. The number of divisions on the axis can be set to 5, 10, 15 or 20. Increasing the number of divisions results in a finer axis grid. Decreasing the number of divisions results in a courser axis grid. This does not affect the way the data are displayed on the graph.

10.2.6.3. Storing Downloaded Data to a File

Follow these steps to save downloaded data to a file:

1) **When in the RPComm Download Data screen (Figure 10-33) with storage data displayed, select the Save icon**  **on the tool bar. The Save Dialog box will appear and prompt the user for a file name. The default file name is:**

nnnnnsyy.txt

where:	nnnnn	=	the unit's serial number
	s	=	data type (s = storage data)
	yy	=	file number (01, 02, etc.)

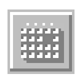
2) **Once you have chosen a file name, select the "Save" button.**
3) **The file will be saved in a comma-delimited ASCII format which can be imported into any spreadsheet program. The data include all column heading information.**

10.2.7. Scheduling Data Downloads

RPComm's automatic download capability allows the user to schedule automatic data downloads from a unit up to four times a day.

> NOTE: The Windows operating system screens shown in this section are from the Windows 98 or XP operating systems. These screens may vary slightly from your computer's screens if you are operating RPComm under other Windows operating systems.

Follow these steps to schedule an automatic data download:

1) **When in the RPComm Connection List screen, ensure that a new connection or other connection name is selected (Figure 10-29).**
2) **When in the RPComm Connection List screen, select the Schedule Download icon  on the tool bar. The Schedule Downloads screen (Figure 10-37) will now display.**

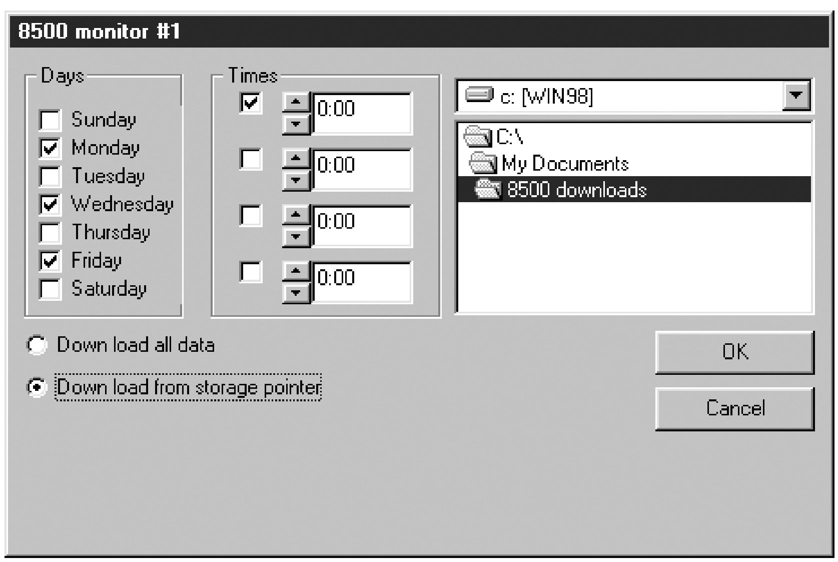


Figure 10-37. Schedule Downloads screen.

3) Select the box next to the day(s) of the week that you want the data to be downloaded. You may choose a single day each week or any other combination of days.

4) Select the time(s) on the chosen day(s) that the data are to be downloaded. The data can be downloaded up to four times a day.

5) Select the directory location where you want the downloaded data to be stored. Thermo recommends that you create a separate directory for data downloads, and that you remove these files from this directory on a regular basis because the file serial number can track only 100 files. The data file will be saved under a file name according to the following convention:

nnnnnsyy.txt

where:	nnnnn	=	the unit's serial number
	s	=	data type (s = storage data)
	yy	=	file number (01, 02, etc.)

6) Select which data files are to be downloaded.

7) When the schedule has been completed, select "OK" to save your changes. The scheduled downloads for the next 24 hours are listed in the scheduled download list on the Connection List screen. For example, Figure 10-38 shows a scheduled download for 08/28/2002 at 12:00 pm for unit 8500, Site #1.

Figure 10-38. Example of a scheduled download in the RPComm Connection List screen.

8) Data downloads can be scheduled for each connection listed in the connection list. If more than one download is scheduled for the same time, the downloads will occur in the order that they are listed in the Scheduled Download box.

NOTE: Thermo recommends that you schedule data downloads to occur 5 minutes apart to ensure smooth data transmission.

During a scheduled download, RPComm assigns file numbers or names to the downloaded data according to the file numbers that already exist in the download directory. RPComm increments the file numbers by a value of one more than the largest file number that already exists in the download directory.

For example, if the download directory has one file in it with the number 20114s01.txt, at the next scheduled data download RPComm will assign the file name 20114s02.txt to the new downloaded data. The number “02” was the next available file number.

10.2.8. Viewing Instrument Operation

NOTE: The Windows operating system screens shown in this section are from the Windows 98 and XP operating systems. These screens may vary slightly from your computer's screens if you are operating RPComm under other Windows operating systems.

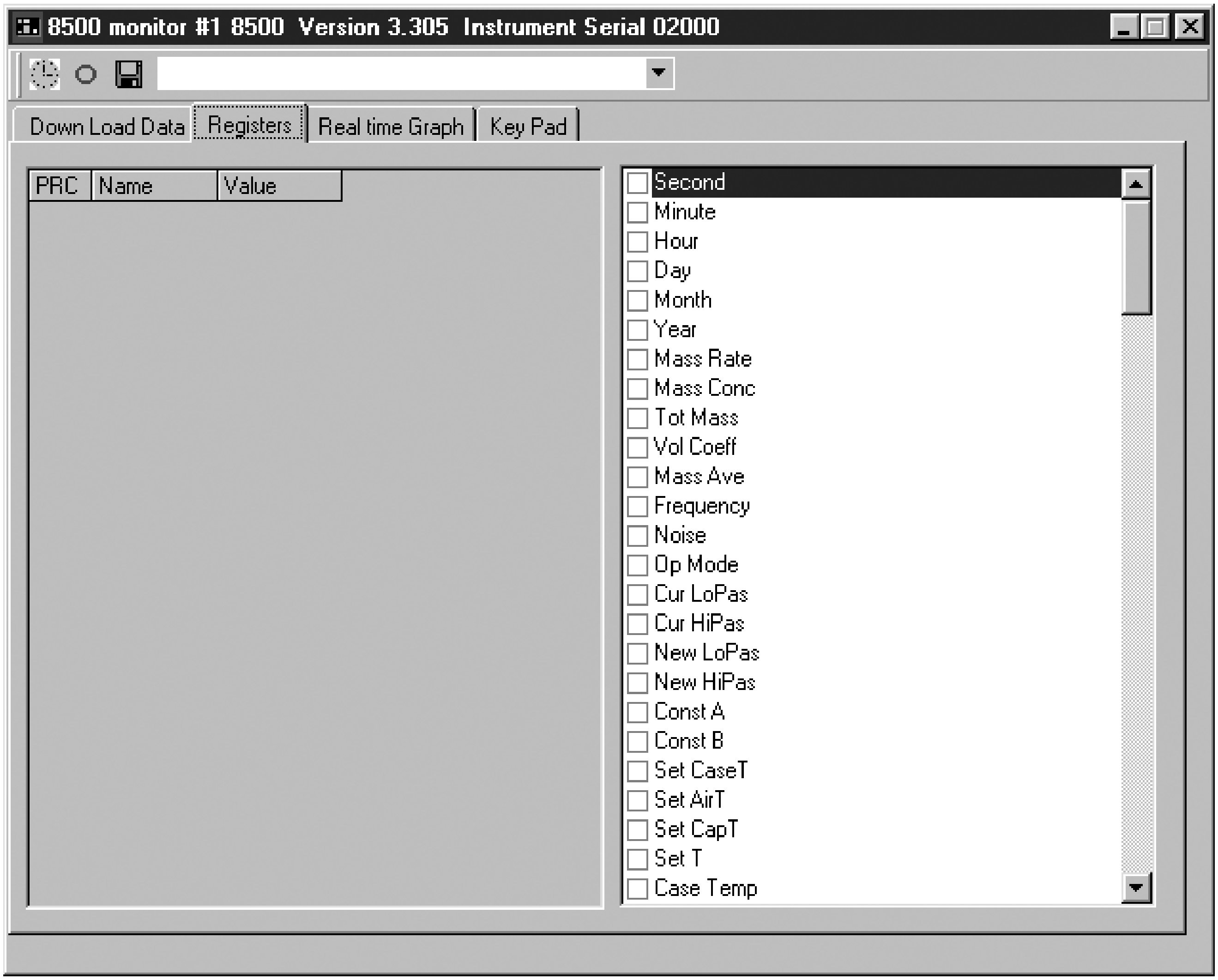
10.2.8.1. Viewing System Registers

A system register is a value entered into, calculated by, or measured by the unit. Examples of system registers are the unit's serial number (entered into), the calibration constants (calculated by), and the ambient temperature (measured by). Every system register can be displayed by RPComm.

Follow these steps to view system registers:

1) **When in the RPComm Download Data screen (Figure 10-33), select the Registers tab to display the Registers screen (Figure 10-39).**

Figure 10-39. Registers screen.



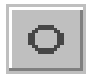
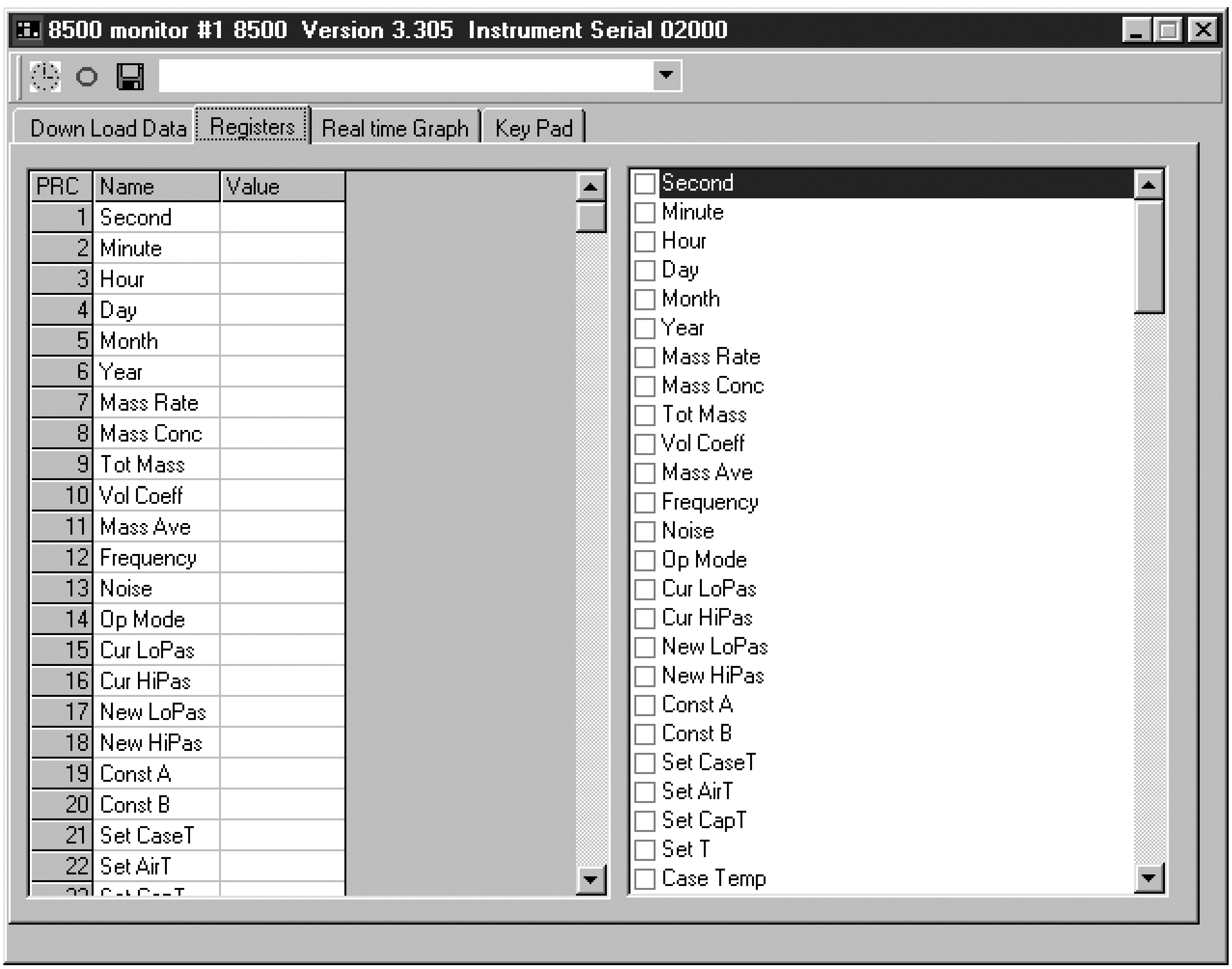
2) On the right-hand side of the Registers screen is a list of all the system registers (Figure 10-40). Using the scroll bar, examine the list of registers and place a checkmark next to the registers that you wish to view. Or, if desired, select the Select All Registers icon  on the tool bar to choose all the registers. As registers are selected, they will appear on the left-hand side of the screen.

Figure 10-40. Registers screen with all registers selected.



3) Select the Read Registers icon on the tool bar to read the selected registers from the unit. All the current values will appear in the list on the left-hand side of the screen next to their corresponding labels (Figure 10-41).

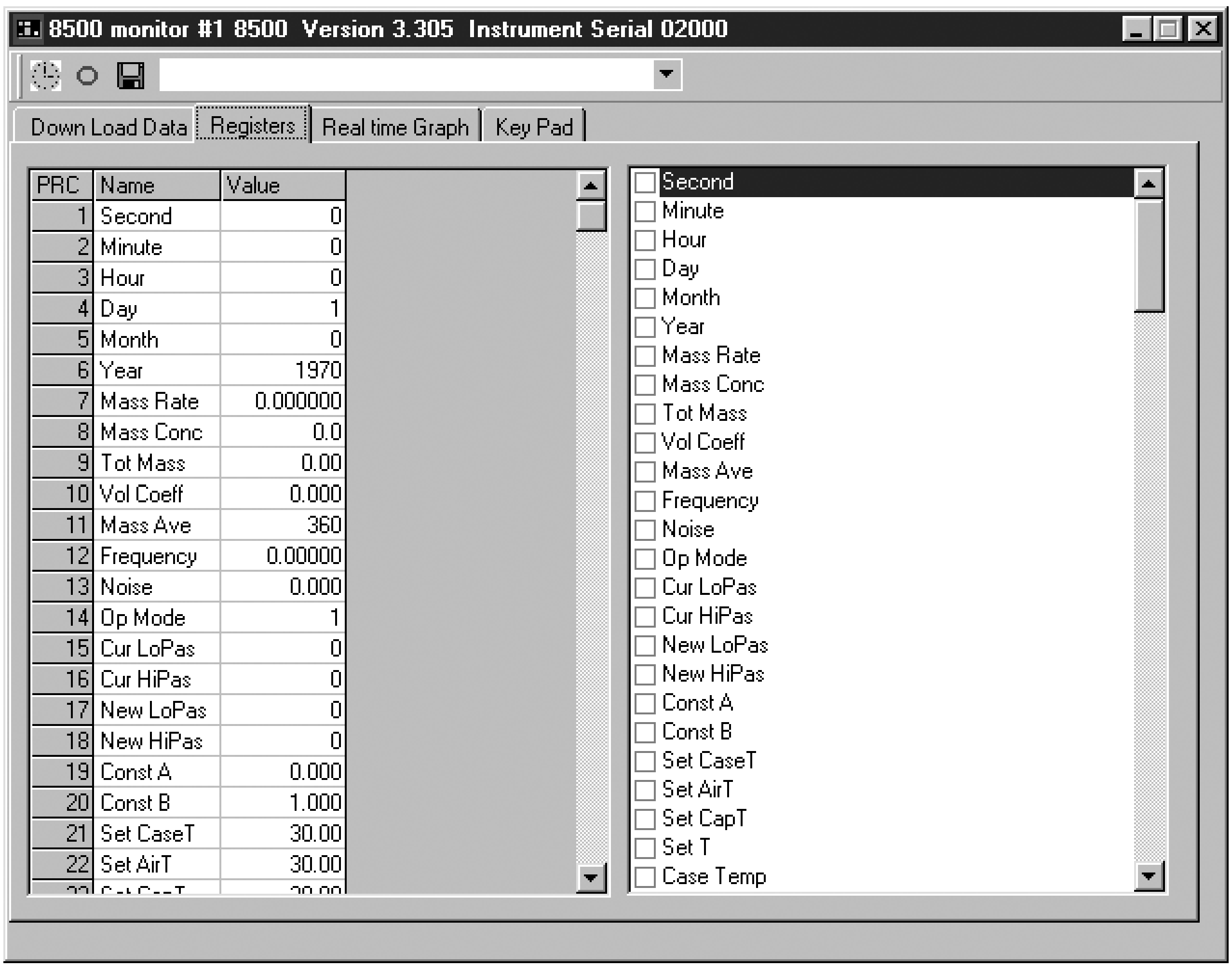


Figure 10-41. Registers screen with all current values displayed.

4) To save the register list to a file, select the Save icon on the tool bar. The user will then be prompted to select a location and file name. This list can be useful for troubleshooting.

10.2.8.2. Viewing Instrument Keypad

A virtual keypad is available for use through RPComm. This keypad looks exactly like the keypad on the control unit and shows what is currently being displayed on the control unit's screen.

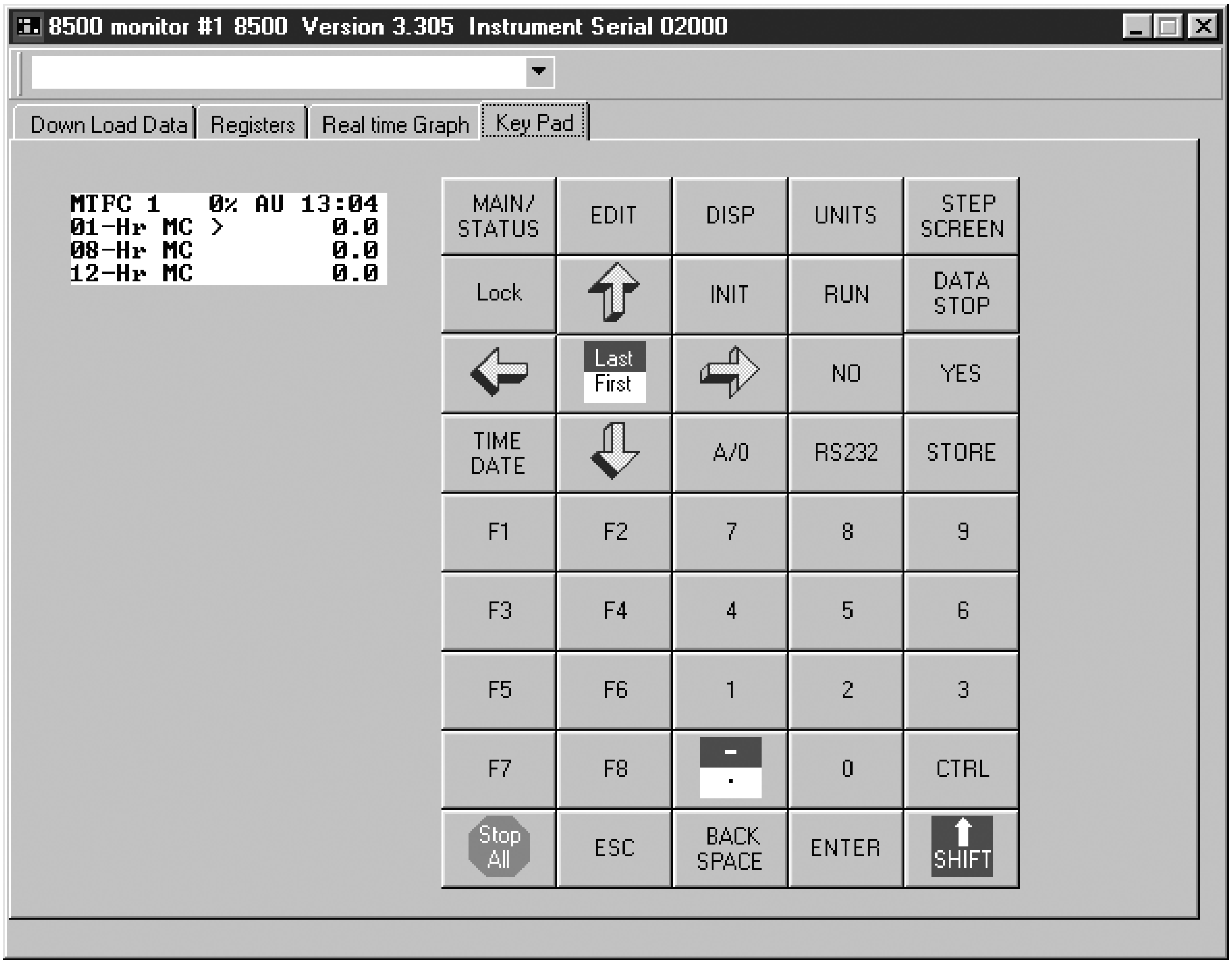
Follow these steps to view the virtual keypad:

1) **When in the RPComm Download Data screen (Figure 10-33), select the Keypad tab to display the virtual keypad (Figure 10-42).**

   NOTE: If the virtual display shows a number line as the top line and does not show the proper display, RPComm is not communicating with the unit properly.

2) **Operate the virtual keypad as you would the keypad on the control unit.**

Figure 10-42. Virtual keypad.



10.2.9. Creating a Real-Time Graph

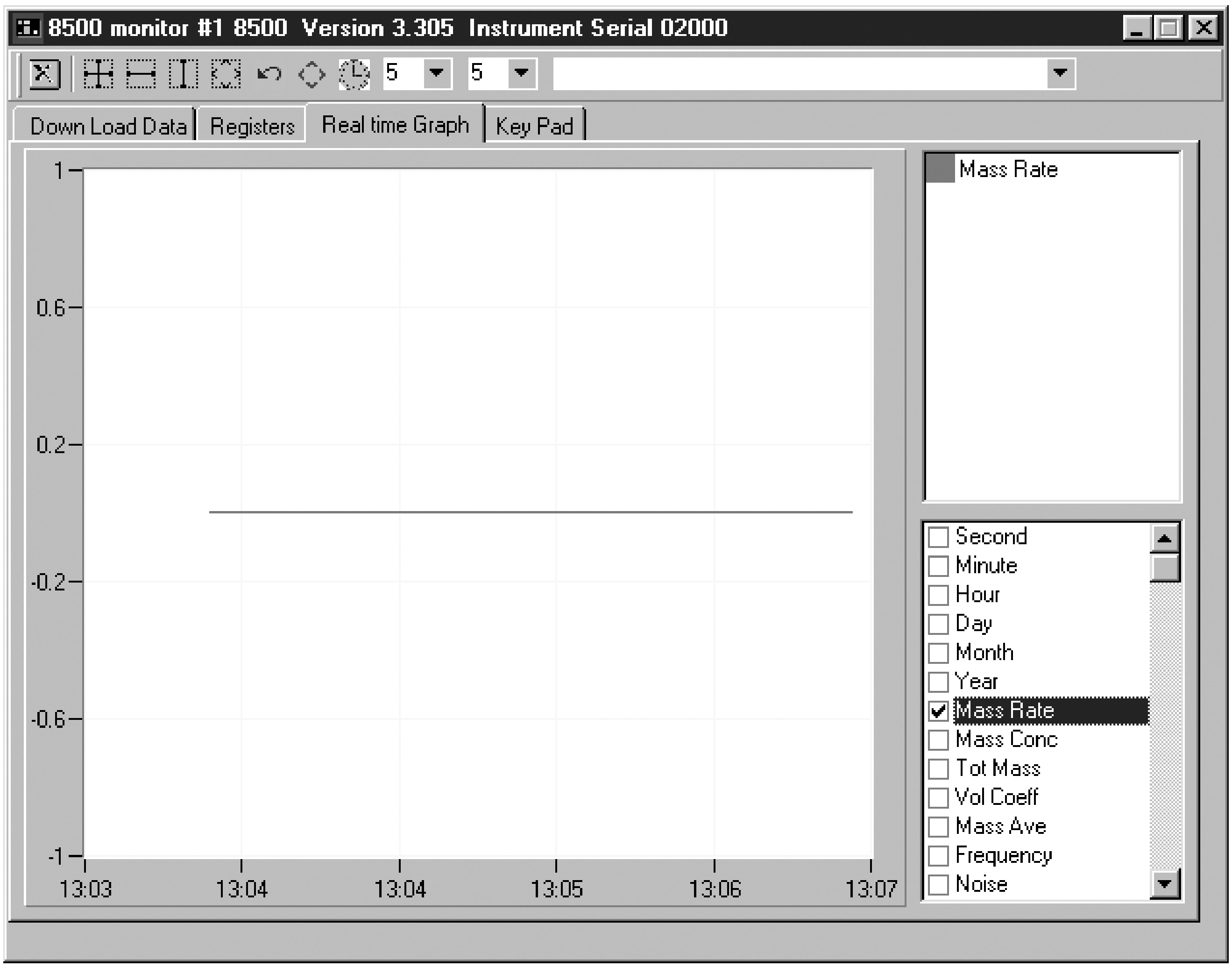
RPComm can display any system register(s) in a real-time graph. Each register value is updated and graphed every second.

> NOTE: The Windows operating system screens shown in this section are from the Windows 98 and XP operating systems. These screens may vary slightly from your computer's screens if you are operating RPComm under other Windows operating systems.

Follow these steps to create a real-time graph:

1) When in the RPComm Download Data screen (Figure 10-33), select the Real-Time Graph tab to display the Real-Time Graph screen (Figure 10-43).

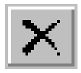
Figure 10-43. Real-Time Graph screen.



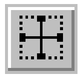
2) In the bottom, right-hand corner of the screen is a list of system registers. Using the scroll bar, examine the list of registers and place a checkmark next to the registers that you wish to graph. As registers are chosen, the values will appear on the graph. The color key on the top, right-hand corner of the screen shows the variables being graphed and their corresponding colors.

3) Refer to Figure 10-44 for a complete description of the control buttons on the Real-Time Graph screen.

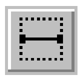
Figure 10-44. Control buttons on the Real-Time Graph screen.



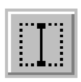
Clears all data listed on the right-hand side of the Real-Time Graph screen. This includes data being displayed.



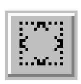
Decreases the scale of the x- and y-axes concurrently. With this icon selected, press and hold down the left mouse button and make a box around the area (inside the graph) that you want to zoom into. Once the box is finished, let go of the mouse button. The graph will be resized according to the box dimensions.



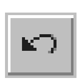
Decreases the scale of the x-axis. With this icon selected, press and hold down the left mouse button at the beginning of the area that you want to zoom into. Drag the cursor horizontally to the end of the zoom area and let go of the mouse button. The graph will be resized according to the new x-axis dimensions.



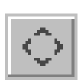
Decreases the scale of the y-axis. With this icon selected, press and hold down the left mouse button at the beginning of the area that you want to zoom into. Drag the cursor vertically to the end of the zoom area and let go of the mouse button. The graph will be resized according to the new y-axis dimensions.



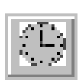
Enables panning. Panning allows the user to move the graph area so that a different section of the x- or y-axis is being displayed without affecting the scale of either axis. With this icon selected, place the mouse cursor somewhere within the graph area and hold down the left mouse button. Move the mouse so that the desired section of the graph is displayed.



Selecting this icon will undo the last zoom or panning step.



Rescales the x- and y-axes so that all the graphs for the selected data are displayed.



Toggles between the two possible x-axis scales: date and time, and time only. This does not affect the way the data are displayed on the graph.

These two boxes define the number of axis divisions on the graph. The box on the left refers to the x-axis and the box on the right refers to the y-axis. The number of divisions can be set to 5, 10, 15 or 20 divisions. Increasing the number of divisions results in a finer axis grid. Decreasing the number of divisions results in a courser axis grid. This does not affect the way the data are displayed on the graph.

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Section 11: Password Protection

The Series 8500 FDMS Monitor offers three levels of keypad locking: 1) unlock mode, 2) low lock mode, and 3) high lock mode. The Main screen displays the current keypad locking level on its status line (Figure 11-1). The instrument is always in the unlock mode when it is first shipped, allowing the user full access to all of the functions of the monitor.

A

```
OK     4+  21%  NU     09:39
Mass Conc               11.5
01-Hr MC                12.5
08-Hr MC                 8.3
```

Figure 11-1. Main screen with keypad locking level (A) highlighted.

The three states of password protection are defined as:

Unlock (U) mode	The user has access to all capabilities of the instrument.
Low lock (L) mode	The user can view all of the instrument screens or restart data collection by pressing <F1> or <RUN>, but cannot edit any of the system variables. Also, the user can change the operating mode of the instrument while in the low lock mode to perform functions such as a filter exchange.
High lock (H) mode	The user cannot make any changes from the keypad except for turning off the high lock mode with the proper password. Also, the user can only view the operation of the instrument through the current screen on the four-line display. The keys for moving the cursor and switching to different screens are disabled when the monitor is in the high lock mode.

11.1. Initiating the Low Lock Mode

✔ In low lock protection mode, the user can not edit any of the parameters in the system.

Follow these steps to enter and exit the low lock mode:

1) Press <LOCK> on the monitor's keypad. The monitor will display an "x" in place of the usual ">" cursor on the four-line display.

2) Enter the six-digit numeric low lock password, and then press <ENTER>.

NOTE: When the instrument is shipped, the low lock password is "100000."

3) To return to the unlock mode, repeat steps 1-2.

11.2. Initiating the High Lock Mode

Follow these steps to enter and exit the high lock mode:

✔ In high lock protection mode, the user can not edit any of the parameters in the system or view different display screens.

1) **Press and hold the <SHIFT> key on the monitor's keypad.**
2) **Press <LOCK>. The monitor will display an "x" in place of the usual ">" cursor on the four-line display.**
3) **Release the <SHIFT> key.**
4) **Enter the six-digit numeric high lock password, and then press <ENTER>.**

   NOTE: When the instrument is shipped from R&P, the high lock password is "100000."

5) **To return to the unlock mode, repeat steps 1-4 and then follow the instructions in Section 11.1.**

11.3. Set Passwords Screen

The Set Passwords screen (Figure 11-2) allows users to change the low and high lock passwords. The low and high passwords can be changed while in any operating mode.

Figure 11-2. Set Passwords screen.

```
        SET PASSWORD
Cur Lo Pass>            *
New Lo Pass             *
Cur Hi Pass             *
```

11.3.1. Changing the Low Password

Follow these steps to change the low password:

1) **In the Main screen, press <STEP SCREEN> to display the Menu screen.**
2) **In the Menu screen, press the up or down arrow keys to select "Set Passwords."**
3) **Press <ENTER> to display the Set Passwords screen. Also, to display the Set Passwords screen, press <1>, <0> and then <ENTER> when in any screen.**
4) **Press the up or down arrow keys to place the cursor on the "Cur Lo Pass" line.**
5) **Enter the current password on the "Cur Lo Pass" line. If you enter the current password incorrectly, the instrument will beep and erase the entry.**
6) **Press the up or down arrow keys to place the cursor on the "New Lo Pass" line.**
7) **Enter the new six-digit numeric password on the "New Lo Pass" line. This six-digit code will now become the new low lock password.**

11.3.2. Changing the High Password

Follow these steps to change the high password:

1) In the Main screen, press <STEP SCREEN> to display the Menu screen.
2) In the Menu screen, press the up or down arrow keys to select "Set Passwords."
3) Press <ENTER> to display the Set Passwords screen. Also, to display the Set Passwords screen, press <1>, <0> and then <ENTER> when in any screen.
4) Press the up or down arrow keys to place the cursor on the "Cur Hi Pass" line.
5) Enter the current password on the "Cur Hi Pass" line. If you enter the current password incorrectly, the instrument will beep and erase the entry.
6) Press the up or down arrow keys to place the cursor on the "New Hi Pass" line.
7) Enter the new six-digit numeric password on the "New Hi Pass" line. This six-digit code will now become the new high lock password.

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Section 12: Routine Maintenance and Verification Procedures

This section describes the routine maintenance and verification procedures for the Series 8500 FDMS Monitor.

12.1. Routine Maintenance Procedures

Maintenance Procedures	Interval
Sample inlet	Clean the sample inlet that is mounted on the tripod each time that you exchange a TEOM filter, or as necessary (Appendix G).
Large in-line filters	Replace the large in-line filters every 6 months, or as necessary (Section 12.1.1).
Air inlet system	Clean the air inlet system inside the mass transducer once a year, or as necessary (Section 12.1.2).
Switching valve	Clean the switching valve inside the 8500 module each time that you clean the sample inlet that is mounted on the tripod, or as necessary (Section 12.1.3).
Sample pump	Rebuild the sample pump once every 18 months, or as necessary. The pump rebuild kit (59-008630) contains instructions for rebuilding the pump that was shipped with the Series 8500 FDMS Monitor.

These maintenance intervals are guidelines. Requirements for routine maintenance are site-specific, and may vary from one location to another.

12.1.1. Exchanging the Large In-Line Filters

The large in-line filters (57-002758) should be changed every 6 months or as necessary. They are located on the main (SENSOR FLOW) and auxiliary (BYPASS FLOW) lines on the back of the control unit. These filters prevent contamination from reaching the flow controllers. For convenience, replace the large in-line filters immediately following one of the regularly-scheduled TEOM filter exchanges (Section 3). This allows you to exchange the large in-line filters during the 30-minute flow and temperature stabilization period (Section 4).

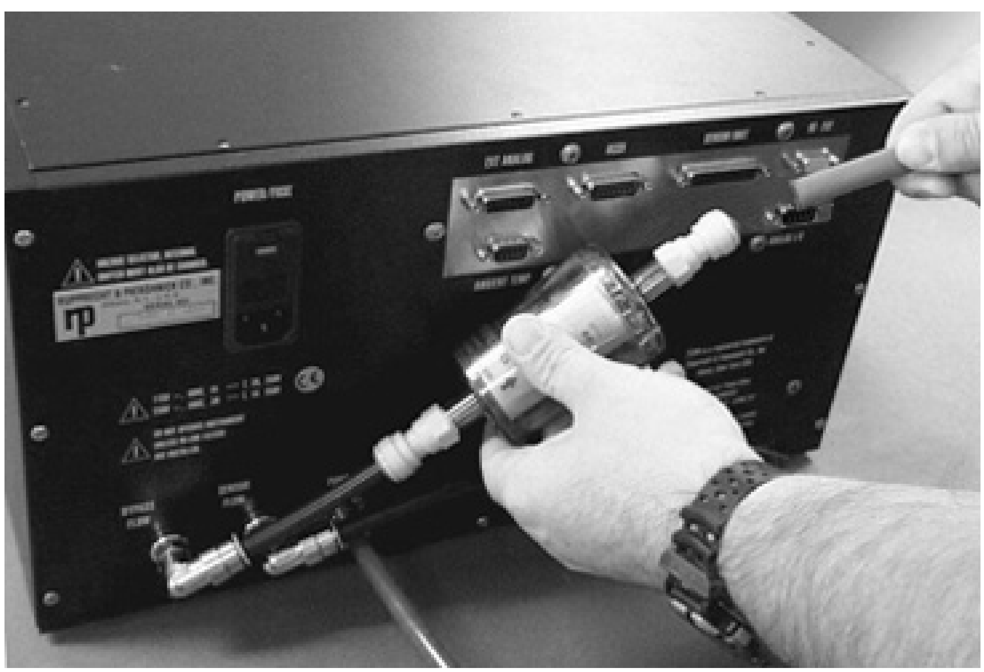
✔ The instrument must be operated with both large in-line filters installed to avoid contamination of the flow controllers.

Tools needed: None
Materials: 2 large in-line filters (57-002758)

Follow these steps to exchange the large in-line filters:

1) **Remove the existing large in-line filters from their quick-connect fittings.**
2) **Install new large in-line filters onto the quick-connect fittings (Figure 12-1). Ensure that the arrows on the filters point away from the control unit (against the flow). This will allow the user to see the contamination as it is collected on the filter.**

Figure 12-1. Replacing a large in-line filter.



12.1.2. Cleaning the Air Inlet System

You must clean the heated air inlet in the Series 1400a sensor unit once a year to remove the buildup of particulate matter on its inner walls. You can order a tapered bristle brush (30-002227) that is appropriate for cleaning the air inlet system from Thermo.

Tools needed: Piece of plastic or another protective material
Soapy water, alcohol or freon solution
Soft brush

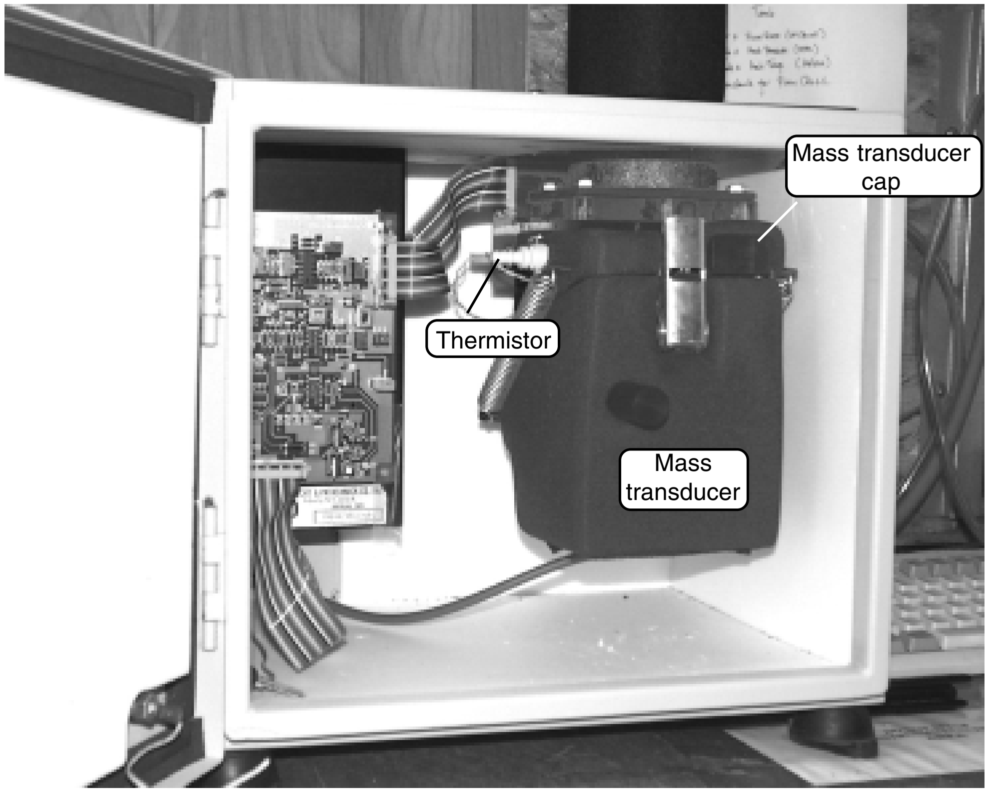
Follow these steps to clean the air inlet system:

1) Turn off the control unit.

2) Open the door of the sensor unit (Figures 12-2 and 12-3).

Figure 12-2. Series 1400a sensor unit.

Figure 12-3. Sensor unit with door open.

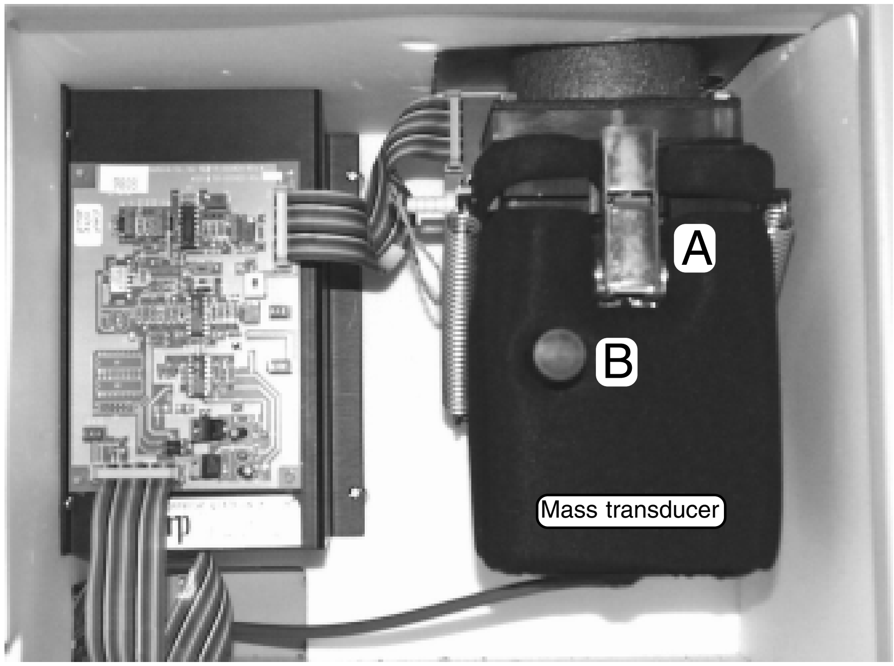


3) With the mass transducer in its closed, upright position, locate the thermistor in the cap of the mass transducer (Figure 12-3).

4) Press on the metal locking-clip of the thermistor and pull it out of the cap.

5) Locate the silver handle on the front of the mass transducer (Figure 12-4). Note that there is a shipping latch in the middle of this handle.

Figure 12-4. Mass transducer in the closed position with the silver handle (A) and black knob (B) highlighted.

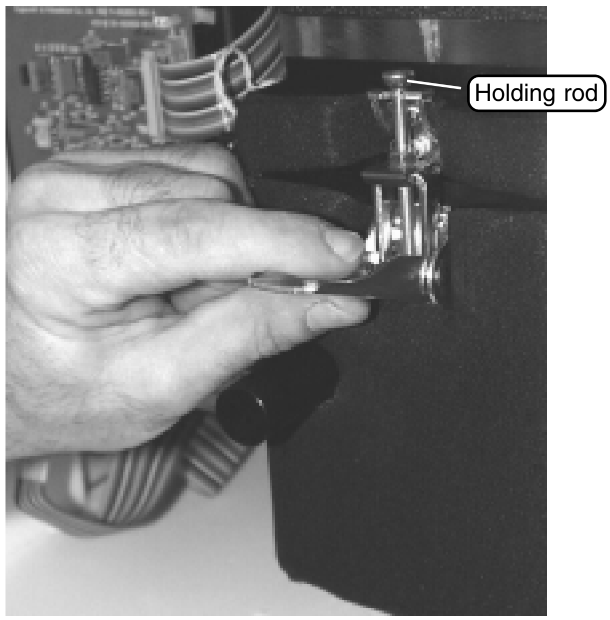


6) **Grasp the silver handle and move the shipping latch upward with your thumb (Figure 12-5).**

Figure 12-5. Lifting the shipping latch on the silver handle.

7) Pull down on the silver handle (Figure 12-6).

Figure 12-6. Pulling the silver handle down.



8) Pull the holding rod off the latch plate (Figure 12-7).

Figure 12-7. Releasing the holding rod on the mass transducer.

9) With the mass transducer unlatched, grasp the black knob (Figure 12-4) and swing the bottom of the mass transducer downward, exposing the tapered element (TE) (Figures 12-8 and 12-9).

Figure 12-8. Opening the mass transducer.

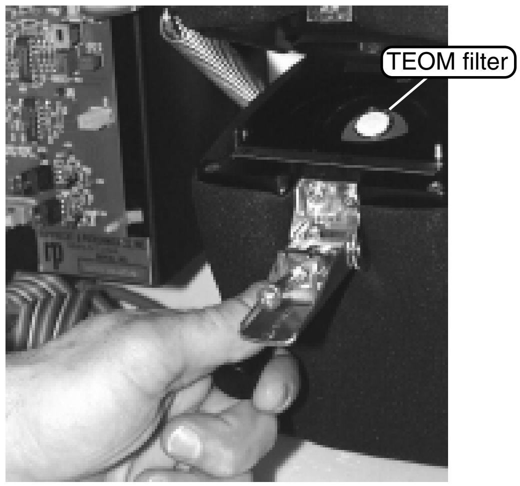
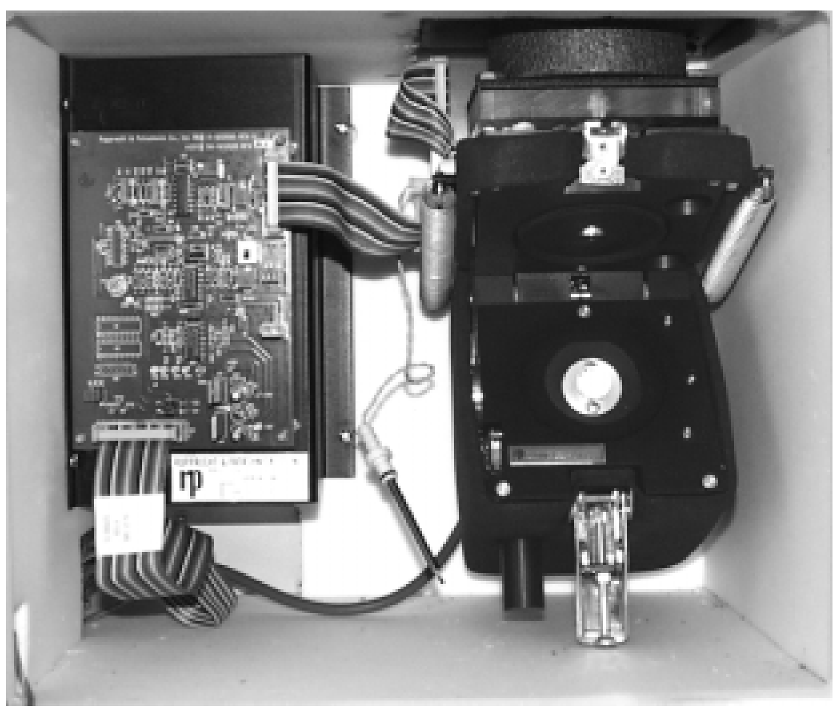


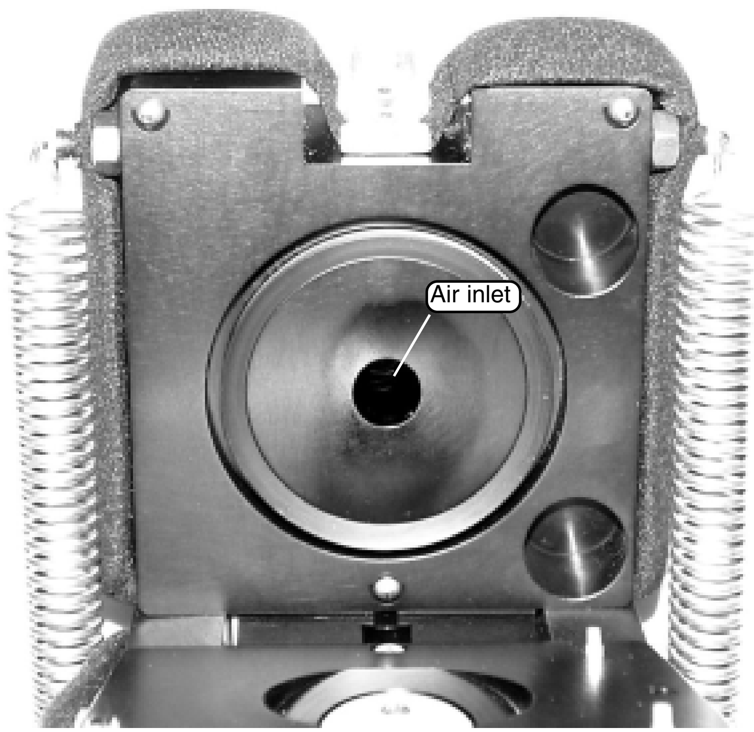
Figure 12-9. The mass transducer in its open position with thermistor removed.



10) **Place a piece of plastic or another protective material over the exposed TEOM filter.**

11) **Using a soapy water, alcohol or freon solution, clean the entire air inlet (Figure 12-10). A soft brush may be used to remove particulate matter on the insides of the walls.**

Figure 12-10. Air inlet inside the mass transducer.



12) **Allow the air inlet to dry.**

13) **Remove the protective material from the exposed TEOM filter.**

14) **Raise the mass transducer to the closed position using the black knob.**

15) Fasten the holding rod onto the latch plate.

16) Push the silver handle up until the shipping latch snaps into place.

17) Reinsert the air thermistor into the cap of the mass transducer assembly.

18) Close and latch the door to the sensor unit. Keep the door open for as short a time as possible to minimize the temperature change in the system.

19) Turn on the control unit.

12.1.3. Cleaning the Switching Valve

You must clean the switching valve that is located inside the 8500 module each time that you clean the sample inlet that is mounted on the tripod, or as necessary.

Tools needed: Valve cleaning brush

Follow these steps to clean the switching valve:

1) **Press the <DATA STOP> key on the monitor's keypad to enter the Setup Mode (Section 6).**

2) **Locate the 8500 module (Figure 12-11).**

Figure 12-11. 8500 module.

3) **Locate the valve signal cable and the valve position cable on the back of the 8500 module (Figure 12-12).**

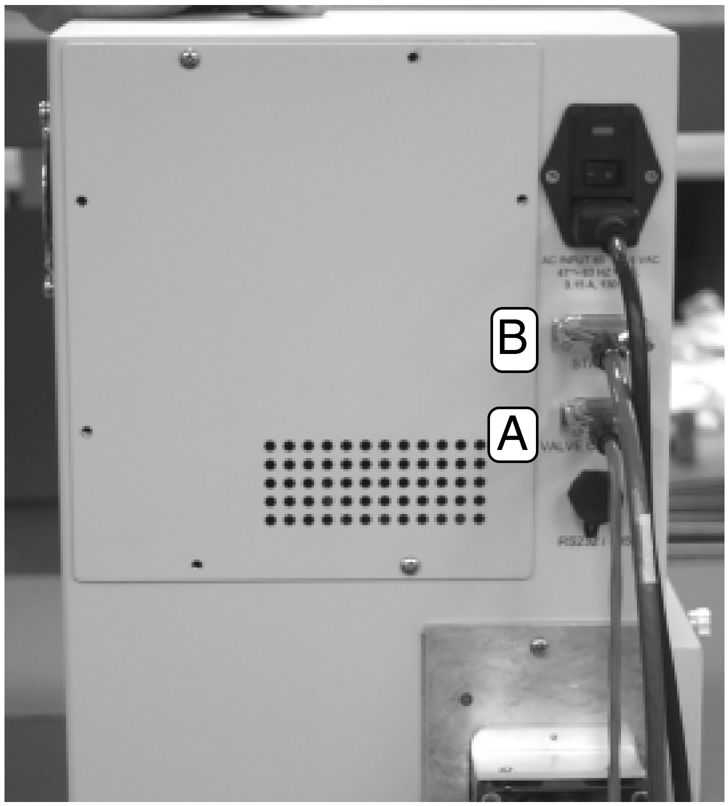


Figure 12-12. Valve signal cable (A) and valve position cable (B) installed onto the back of the 8500 module.

4) **Disconnect the 9-pin valve signal cable from the 9-pin "VALVE CONTROL" connection port (Figure 12-12).**

5) **Locate the 3-inch black insulation sleeve that is installed on the sample inlet between the sensor unit and 8500 module (Figure 12-13).**

Figure 12-13. 3-inch insulation sleeve installed onto the exposed sample inlet.

6) Remove the 3-inch black insulation sleeve from the sample inlet.

7) Loosen the Swagelok fitting that connects the sensor unit's inlet to the main flow outlet on the 8500 module (Figure 12-14).

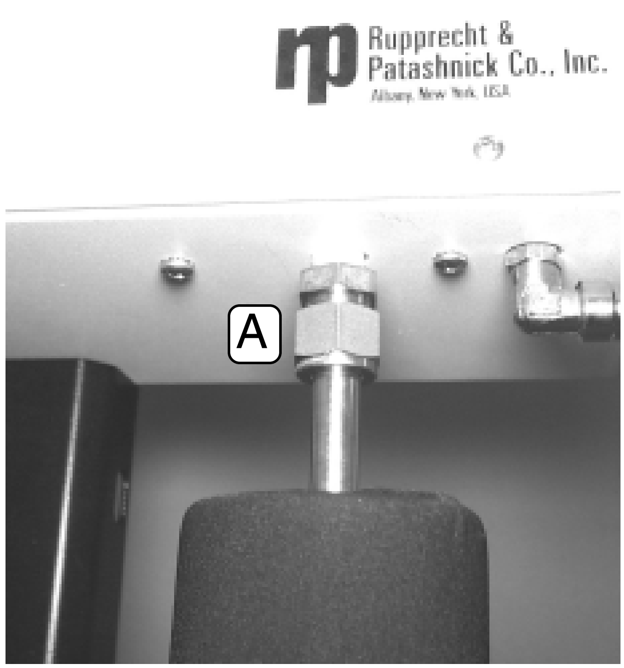
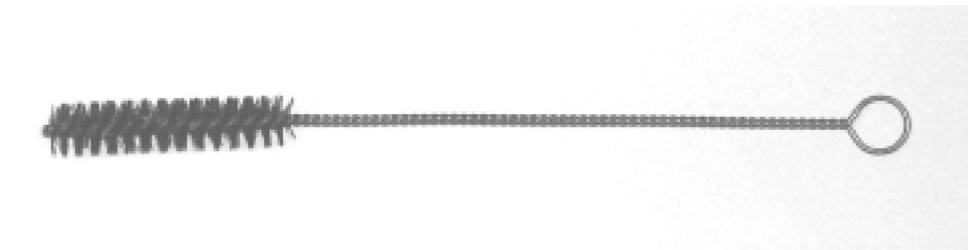


Figure 12-14. 8500 module installed onto the sensor unit's inlet with the Swagelok fitting (A) highlighted.

8) Remove the sensor unit's inlet from the main flow outlet port on the bottom of the 8500 module.

9) Locate the valve cleaning brush (Figure 12-15).

Figure 12-15. Valve cleaning brush.



✘ **IMPORTANT: DO NOT** insert the brush more than 4 1/2-inches into the 8500 module. Inserting the brush further than 4 1/2-inches into the 8500 module will damage the SES dryers.

10) Insert the brush into the main flow outlet port, and gently scrub the inside surface of the switching valve (Figures 12-16 and 12-17).

IMPORTANT: DO NOT insert the brush more than 4 1/2-inches into the 8500 module. Inserting the brush further than 4 1/2-inches into the 8500 module will damage the SES dryers.

Figure 12-16. Inserting the valve cleaning brush into the main flow outlet port.

Figure 12-17. Cleaning the switching valve with the valve cleaning brush.

✘ **IMPORTANT: DO NOT** insert the brush more than 4 1/2-inches into the 8500 module. Inserting the brush further than 4 1/2-inches into the 8500 module will damage the SES dryers.

11) Remove the brush from the main flow outlet port.

12) Install the 8500 module's main flow outlet port onto the sample inlet of the sensor unit (Figure 12-14). Be sure to tighten the Swagelok fitting 1-1/4 turn past finger-tight with a wrench.

13) Locate the 3-inch insulation sleeve that you removed in step 6.

14) Install the insulation sleeve onto the exposed sample inlet between the sensor unit and 8500 module (Figure 12-13).

15) Install the 9-pin valve signal cable into the 9-pin "VALVE CONTROL" connection port on the back of the 8500 module (Figure 12-12).

16) Press <F1> or <RUN> on the monitor's keypad to resume normal instrument operation.

12.2. VERIFICATION PROCEDURES

Verification Procedures	Interval
Batteries	Test the batteries once every 6 months, and exchange them as necessary (Service Manual).
Pump	Test the pump once every 6 months (Service Manual).
Mass flow controller:	
Software	Calibrate the mass flow controller's software once every 6 months (Service Manual).
Hardware	Calibrate the mass flow controller's hardware once a year (Service Manual).
Analog I/O	Perfom an analog input/output calibration once every 1 to 2 years (Service Manual).
Leak check	Perform a leak check once a year, or as necessary (Section 3.5).
Mass transducer	Verify the calibration of the mass transducer once a year (Section 12.2.1).
Ambient air temperature	Verify the ambient air temperature measurement once a year (Section 12.2.2).
Ambient pressure	Verify the ambient pressure measurement once a year (Section 12.2.3).
Flow audit	Perform a flow audit once a year (Section 12.2.4).
Ambient temperature sensor	Calibrate the ambient temperature sensor once a year (Service Manual).
Ambient pressure sensor	Calibrate the ambient pressure sensor once a year (Service Manual).

The verification intervals provided above are guidelines. Requirements for verifications are site-specific, and may vary from one location to another.

12.2.1. Mass Transducer Calibration Verification

The calibration of the mass transducer in the Series 8500 FDMS Monitor is determined by the mass transducer's physical mechanical properties. Under normal circumstances, the calibration does not change materially over the life of the instrument. Contact Thermo if the results of the verification procedure indicate that the a calibration constant has changed by more than 2.5% from the original calibration constant. You can locate the original calibration constant on the "Instrument Checkout Record" or the "Final Test Record" documents that are shipped from the factory with the instrument.

Before the Series 8500 FDMS Monitor is shipped to the customer, it is calibrated with a new, pre-weighed TEOM filter installed in its mass transducer as a calibration weight. Because the mass of the filter cartridge with particulate matter differs from the mass of a new filter cartridge by only a small fraction, calibrating the system with a calibration mass equivalent to the filter mass allows all measurements to be made at essentially the same operating point as the original calibration. Refer to Section 1 for a detailed explanation of how the calibration constant, K_0, is derived.

12.2.1.1. K0 Confirmation Screen

The K0 Confirmation screen (Figure 12-18) allows the user to verify the monitor's K_0 calibration.

Figure 12-18. K0 Confirmation screen.

```
K0 Confirm        209.44188
>Filt Wght          0.07903
 287.53182        209.44186
 Audit K0              9683
```

Oscillating frequency without a filter

Oscillating frequency with a filter

You can display the K0 Confirmation screen on the four-line display of the control unit in two different ways:

1. In the Main screen (Figure 12-19), press <STEP SCREEN> to display the Menu screen (Figure 12-20). In the Menu screen, press the up and down arrow keys to select "K0 Confirmation," and then press <ENTER>.
2. Press <1> and <7>, and then press <ENTER>.

Figure 12-19. Main screen.

```
OK    4+  21%  NU    09:39
Mass Conc             11.5
01-Hr MC              12.5
08-Hr MC               8.3
```

Figure 12-20. Menu screen.

```
  LISTING OF SCREENS
 >Set Temps/Flows
  Set Hardware
  View Analog Inputs
```

The K0 Confirmation screen contains additional lines that cannot be seen when the screen first displays on the control unit's four-line display (Figure 12-21). Press the up and down arrow keys to view the additional lines of the K0 Confirmation screen.

Figure 12-21. K0 Confirmation screen with additional lines displayed.

```
K0 Confirm       209.44188
>Filt Wght         0.07903
 287.53182       209.44186
 Audit K0             9683
--------------------------
 Actual K0            9627
 % Diff               0.58
```

The K0 Confirmation screen contains the following information:

209.44188	This field contains the current value of the calibration constant (K_0).
Filt Wght	This field contains the weight (g) of the pre-weighed calibration verification filter.
287.53182	This field contains the oscillating frequency (hz) of the tapered element oscillating microbalance (TEOM) with a TEOM filter installed.
209.44186	This field contains the oscillating frequency (hz) of the tapered element oscillating microbalance (TEOM) without a TEOM filter installed.
Audit K0	This field contains the audit value of the calibration constant (K_0).
Actual K0	This field contains the current calibration constant (K_0) value that was entered into the monitor (by R&P or the user).
% Diff	This field contains the percentage difference between the audit value and the currently entered K_0 value.

12.2.1.2. Verifying the Calibration Constant

Tools Needed: Mass calibration verification kit (59-002107)
Pre-weighed calibration filter
Filter exchange tool
Dessicant (for humidity protection)
Humidity indicator

NOTE: Refill kits for the mass calibration verification kit are available from Thermo (59-002019).

Follow these steps to confirm the system's K_0 calibration:

1) When in the Main screen (Figure 12-19), press <DATA STOP> on the monitor's keypad.
2) Press <STEP SCREEN>. The Menu screen will display on the four-line display (12-20).
3) When in the Menu screen, press the up and down arrow keys to select "K0 Confirmation."
4) Press <ENTER>. The "K0 Confirmation" screen will display (Figure 12-18). You also can display the K0 Confirmation screen by pressing <1>, <7> and then <ENTER>.
5) Press <EDIT>.
6) Press the up and down arrow keys to select the "Filt Wght" field.
7) Using the monitor's keypad, enter the weight of the pre-weighed calibration verification filter in the Filt Wght field.
8) Press <F1> or <RUN>.
9) Wait for the oscillating frequency value on the "K0 Confirm" line to stabilize.
10) When the frequency stabilizes, press <FIRST/LAST> to record the frequency (f_0).
11) Install the pre-weighed calibration filter in the instrument (Section 3) and wait for the frequency to stabilize again.
12) When the frequency stabilizes, press the <FIRST/LAST> key to record the frequency (f_1). The instrument will now automatically compute and display the audit value of the calibration constant (K_0) in the "Audit K0" field.

NOTE: If you make any mistakes while performing any of these steps, exit from the K0 Confirmation screen and re-enter it. The unit will reset all values to zero when the user re-enters the screen.

12.2.2. Verifying the Ambient Air Temperature

Perform the ambient air temperature verification (Section 12.2.2), pressure verification (Section 12.2.3) and leak check (Section 3) before executing the flow verification procedure (Section 12.2.4).

Figure 12-22. Set Temps/ Flows screen.

```
     SET TEMPS/FLOWS
T-Case>    30.00     30.00
T-Air      30.00     30.00
T-Cap      30.00     29.98
```

Follow these steps to verify the ambient air temperature:

1) Press <1> and <9>, and then press <ENTER> to display the Set Temps/Flows screen (Figure 12-22).

Figure 12-23. Set Temps/ Flows screen with additional lines displayed.

```
     SET TEMPS/FLOWS
T-Case>    30.00     30.00
T-Air      30.00     30.00
T-Cap      30.00     29.98
--------------------------
F-Main      3.00      3.00
F-Aux      13.67     13.65
T-A/S      25.00     25.00
P-A/S      1.000     1.000
Amb Temp              23.4
Amb Pres             0.988
FAdj Main            1.000
FAdj Aux             1.000
```

2) When in the Set Temps/Flows screen, locate the current ambient temperature reading in the "Amb Temp" field (Figure 12-23).

3) Determine the current temperature (°C) at the ambient temperature sensor using an external thermometer, [°C = 5/9 x (°F - 32)].

4) Verify that the value of the "Amb Temp" field is within ± 2° C of the measured temperature. If this is not the case, perform the ambient temperature calibration procedure (Service Manual).

12.2.3. Verifying the Ambient Pressure

Perform the ambient air temperature verification (Section 12.2.2), pressure verification (Section 12.2.3) and leak check (Section 3) before executing the flow verification procedure (Section 12.2.4).

Follow these steps to verify the ambient pressure:

1) **Press <1> and <9>, and then press <ENTER> to display the Set Temps/Flows screen (Figure 12-22).**
2) **When in the Set Temps/Flows screen, locate the current ambient pressure reading in the “Amb Pres” field (Figure 12-23).**
3) **Determine the current ambient pressure in mm Hg (absolute pressure, not corrected to sea level). Verify the monitor’s ambient pressure by measuring the current ambient station pressure in mm Hg with an external measurement device.**
   - To convert from Atmospheres @ 0° C to mm Hg, multiply by 760.
   - To convert from millibars to mm Hg, multiply by 0.75012.
   - To convert from inches Hg @ 32° F to mm Hg, multiply by 25.4.
4) **Verify that the value of the “Amb Pres” field is within ±10 mm Hg of the measured ambient pressure. If this is not the case, perform the ambient pressure calibration procedure (Service Manual).**

12.2.4. Flow Audit Procedure

The flow audit procedure checks the flow rates in the Series 8500 FDMS Monitor. The tolerances in this audit procedure should not be confused with the tighter specifications outlined in the calibration procedures of the Service Manual.

Perform the ambient air temperature verification (Section 12.2.2), pressure verification (Section 12.2.3) and leak check (Section 3) before executing the flow verification procedure (Section 12.2.4).

Tools Needed: Flow audit adapter kit

Follow these steps to perform a flow audit:

1) Press <F1> or <RUN> on the control unit's keypad.

NOTE: Any data generated by the instrument during this audit procedure are invalid. Therefore, do not run a flow audit procedure during a valid sampling run.

2) Remove the sample inlet from the flow splitter (Figure 12-24).

Figure 12-24. Removing the PM-10 inlet.

3) Locate the flow audit adapter (Figure 12-25).

Figure 12-25. Flow audit adapter with valve open.

4) Ensure that the valve of the flow audit adapter is in its open position (Figure 12-26).

Figure 12-26. Flow audit adapter installed on flow splitter with valve open.

5) Install the flow audit adapter onto the flow splitter (Figure 12-26).

6) When in the Main screen, press the up and down arrow keys until the “Main Flow” (SENSOR FLOW) and “Aux Flow” (BYPASS FLOW) lines display on the screen (Figure 12-27). These values represent the actual volumetric flows as measured by the monitor’s flow controllers.

Figure 12-27. Main screen with “Main Flow” and “Aux Flow” lines displayed.

```
OK    4+  21%  NU     09:44
Main Flow              3.00
Aux Flow              13.66
---------<
```

7) Confirm that these flows are within ±2% of their set points (3.0 l/min for the “Main Flow” and 13.67 l/min for the “Aux Flow”). Any greater deviation may indicate that the in-line filters are plugged or other blockages exist in the system.

8) Attach a reference flow meter such as a bubble meter, dry gas meter, or mass flow meter to the top of the flow audit adapter. This reference flow meter should have been recently calibrated to a primary standard, have an accuracy of ±1% at 3 l/min and 16.67 l/min, and a pressure drop of less than 0.07 bar (1 psi).

9) Read the total flow (approximately 16.67 l/min) on the reference flow meter. If you are using a mass flow meter, you must make any necessary corrections to translate this reading to volumetric l/min at the current ambient temperature and barometric pressure. No adjustment is necessary in the case of a volumetric flow meter. The total volumetric flow measured by the reference flow meter must be 16.67 ±1.0 l/min to be acceptable.

10) Disconnect the bypass flow line from the bypass extension on the bottom of the flow splitter (Figure 12-28).

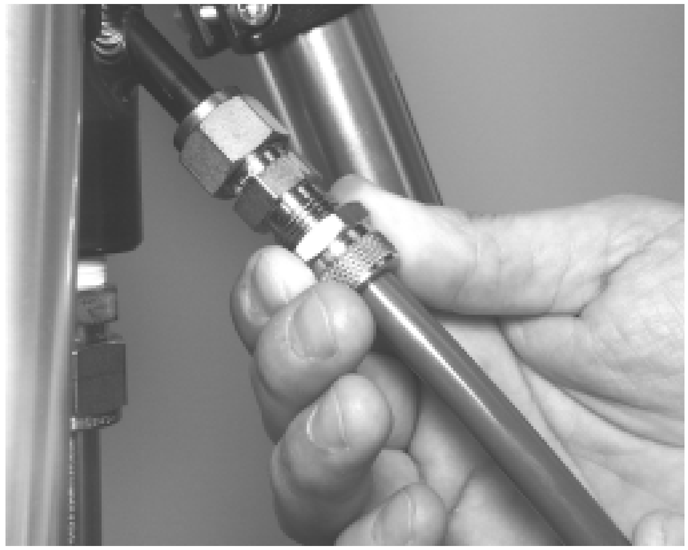


Figure 12-28. Disconnecting the bypass flow line from the bypass extension.

11) Cap the exit of the flow splitter bypass extension with the 3/8-inch Swagelok cap (Figure 12-29).

Figure 12-29. Bypass flow extension with 3/8-inch Swagelok cap.

12) **Read the main flow (approximately 3.0 l/min) on the reference flow meter. If you are using a mass flow meter, you must make any necessary corrections to translate this reading to volumetric l/min at the current ambient temperature and barometric pressure. No adjustment is necessary in the case of a volumetric flow meter. The volumetric flow measured by the reference flow meter must be 3.0 ±0.2 l/min to be acceptable. If the main flow reading is within acceptable limits, go to step 14. If the main flow reading is not within acceptable limits, go to step 13.**

13) **Perform the software and hardware calibrations for the mass flow controller (Service Manual).**

14) **Remove the 3/8" Swagelok cap from the flow splitter bypass extension.**

15) **Install the bypass flow line onto the flow splitter bypass extension.**

16) **Perform a leak check (Section 3.4).**

17) **Remove the flow audit adapter from the top of the flow splitter.**

18) **Install the sample inlet onto the flow splitter.**

19) **Install a new TEOM filter into the mass transducer.**

20) **Press <F1> or <RUN>.**

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Section 13: Resetting the Monitor

This section explains how to initiate an emergency shut-off and reset the instrument to its original settings, and describes what happens to the monitor after a power failure occurs.

13.1. Stop All Command

✔ Press the <STOP ALL> key to shut down all temperature and flow instrumentation.

Certain situations may arise in which the user may want to turn off all temperatures and flows in the instrument. To initiate this procedure, press <STOP ALL> on the control unit's keypad to enter the Stop All Mode and cease data collection. When the instrument is in the Stop All Mode, an "X" will appear in the operating mode field of the Main screen's status line (Section 5).

Also, the monitor will reset its system variables to the original values that were set by the user. Pressing <STOP ALL> does not set the unit to its default parameters.

The instrument will remain in the Stop All Mode until you press <F1> or <RUN> to begin data collection, or press <DATA STOP> to enter the Setup Mode, or turn off the control unit.

13.2. Re-initializing the Instrument

Follow these steps to reset the monitor to its original settings:

1) **Press <DATA STOP> on the control unit's keypad to enter the Setup Mode.**
2) **In the Main screen (Figure 13-1), press and hold the <SHIFT> key.**

Figure 13-1. Main screen.

```
OK    4+  21%  NU     09:39
Mass Conc              11.5
01-Hr MC               12.5
08-Hr MC                8.3
```

3) **Then press <STOP ALL>. This will reset the system variables to their original values.**
4) **Release the <SHIFT> key.**
5) **Follow the procedures in Section 5 (Basic Operation) to enter the appropriate average temperature and pressure for the sampling location, or to select automatic measurement.**

Refer to the program register codes (PRCs) (Appendix B) for a list of the original settings.

13.3. System Operation after a Power Failure

When a power failure occurs and then power is returned to the instrument, the Series 8500 FDMS Monitor automatically resets itself. It will enters the same RS232 mode that it was set at before the power failure occured. Upon starting up again, the instrument waits until temperatures and flow rates have stabilized for 30 minutes before automatically resuming data evaluation and collection. Operating parameters, such as temperature and flow settings, are maintained in the system's battery-backed CMOS memory. The system also contains a battery-backed clock/calendar.

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Appendix A: Overview of Software Screens

This appendix provides an overview of the screens that appear on the Series 8500 FDMS Monitor (Section A.1), and the RPComm (Section A.2), and TEOMCOMM (Section A.3) software applications.

A.1. Series 8500 FDMS Monitor Software Screens

Figure A-1. Hierarchy of Series 8500 FDMS Monitor software screens.

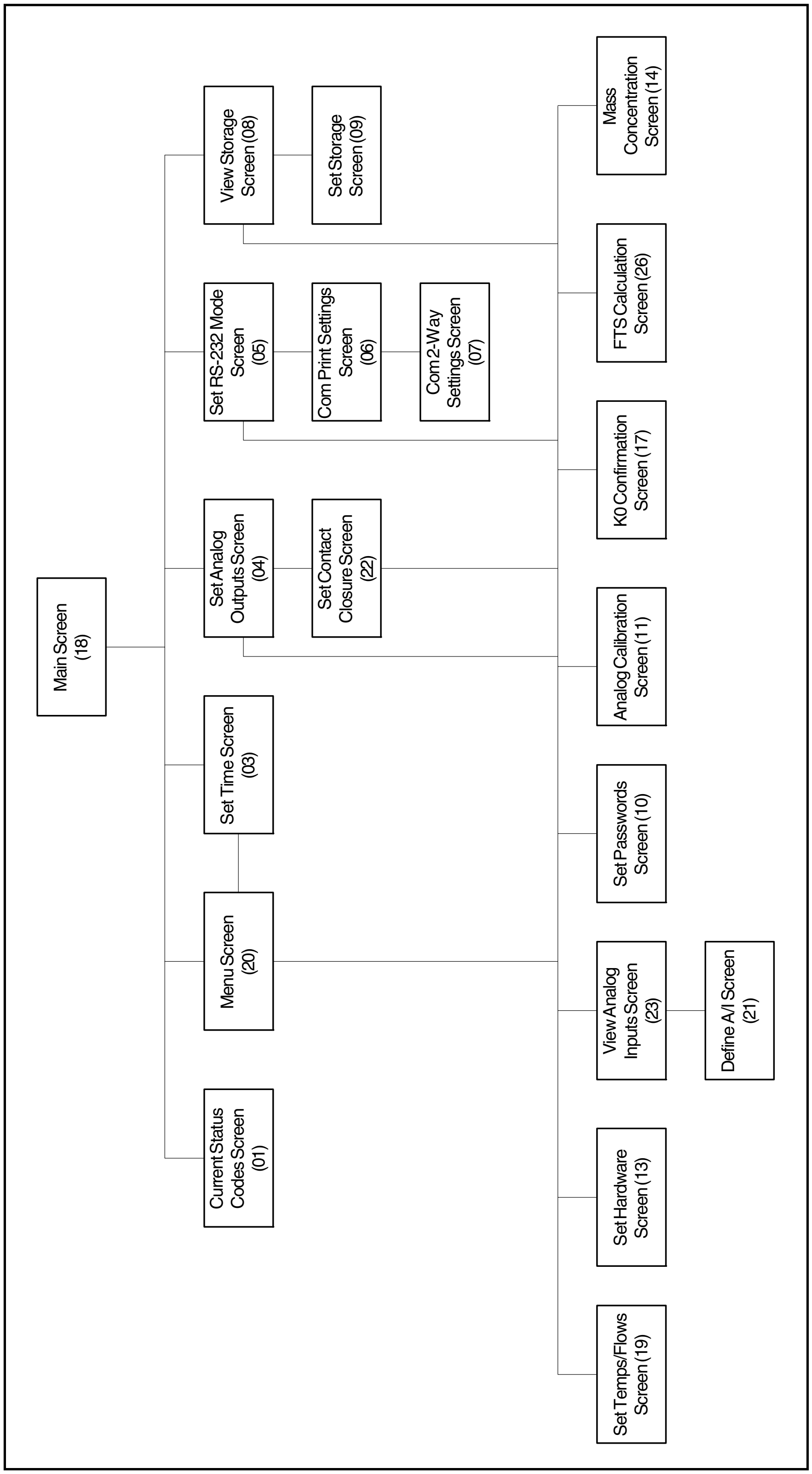


Figure A-2. Title screen.

```
      FDMS Series 8500

      Copyright 2004
  Rupprecht + Patashnick
```

Figure A-3. Main screen.

```
OK    4+  21%  NU     09:39
Mass Conc              11.5
01-Hr MC               12.5
08-Hr MC                8.3
```

Figure A-4. Main screen with additional lines displayed.

```
OK    4+  21%  NU     09:39
Mass Conc              11.5
01-Hr MC               12.5
08-Hr MC                8.3
---------------------------
24-Hr MC               69.3
Tot Mass             974.38
Case Temp             30.00
Air Temp              30.01
Cap Temp              29.98
Main Flow              3.00
Aux Flow              13.66
---------<
Noise                 0.524
Frequency         245.55603
```

Figure A-5. Current Status Codes screen.

```
 CURRENT STATUS CODES
>M        Mass Transducer
 T            Temperature
 F             Flow Rates
```

Figure A-6. Current Status Codes screen with additional lines displayed.

```
 CURRENT STATUS CODES
>M        Mass Transducer
 T            Temperature
 F             Flow Rates
-------------------------
 X        Exchange Filter
 V            Voltage Low
 C          Cooler Status
 P         Valve Position
 D           Drier Status
 I          Inlet RH High
```

Figure A-7. Menu screen.

```
  LISTING OF SCREENS
> Set Temps/Flows
  Set Hardware
  View Analog Inputs
```

Figure A-8. Menu screen with additional lines displayed.

```
  LISTING OF SCREENS
> Set Temps/Flows
  Set Hardware
  View Analog Inputs
  ------------------
  Set Time
  Set Analog Outputs
  Set Contact Closure
  Set RS-232 Mode
  View Storage
  Set Passwords
  Analog Calibration
  K0 Calibration
  FTS Calculation
  Mass Concentration
```

Figure A-9. Set Time screen.

```
        SET TIME
16:20:03        15-Jun-04
Second  >               0
Minute                 20
```

Figure A-10. Set Time screen with additional lines displayed.

```
        SET TIME
16:20:03        15-Jun-04
Second  >               0
Minute                 20
-------------------------
Hour                   16
Day                    15
Month                   0
Year                 2001
```

Figure A-11. Set Analog Outputs screen.

```
   SET ANALOG OUTPUTS
Max Volt >       10-VDC
A01 Var       01-Hr MC
A01 Min            0.00
```

Figure A-12. Set Analog Outputs screen with additional lines displayed.

```
   SET ANALOG OUTPUTS
Max Volt >       10-VDC
A01 Var       01-Hr MC
A01 Min            0.00
-----------------------
A01 Max          500.00
A02 Var       08-Hr MC
A02 Min            0.00
A02 Max          500.00
A03 Var        Tot Mass
A03 Min            0.00
A03 Max         5000.00
Jumpers          10-VDC
```

Figure A-13. Set Contact Closure screen.

```
   SET CONTACT CLOSURE
Cont1 Prc >        Status
  NAND               7.00
Cont2 Prc       Pres Drop
```

Figure A-14. Set Contact Closure screen with additional lines displayed.

```
   SET CONTACT CLOSURE
Cont1 PRC >        Status
  NAND               7.00
Cont2 PRC       Pres Drop
-------------------------
      <             90.00
```

Figure A-15. Set RS-232 Mode screen.

```
      SET RS-232 MODE
  Mode: None
 >None
  Print On Line
```

Figure A-16. Set RS-232 Mode screen with additional lines displayed.

```
     SET RS-232 MODE
  Mode: None
 >None
  Print On Line
-------------------------
  AK Protocol
  German Prot
  Store to Print
```

Figure A-17. Com Print Settings screen.

```
COM PRINT SETTINGS
Interval >            1800
Columns                  6
Prnt Var 1       01-Hr MC
```

Figure A-18. Com Print Settings screen with additional lines displayed.

```
COM PRINT SETTINGS
Interval >            1800
Columns                  6
Prnt Var1        01-Hr MC
-------------------------
Prnt Var2        08-Hr Mc
Prnt Var3        12-Hr MC
Prnt Var4        24-Hr MC
Prnt Var5        Tot Mass
Prnt Var6            Null
Station          48048048
```

Figure A-19. Com 2-Way Settings screen.

```
COM 2-WAY SETTINGS
RS-Para 1 >            52
RS-Para 2           75048
RS-Para 3           13010
```

Figure A-20. Com 2-Way Settings screen with additional lines displayed.

```
COM 2-WAY SETTINGS
RS-Para 1 >            52
RS-Para 2           75048
RS-Para 3           13010
-------------------------
RS-Para 4               0
```

Figure A-21. View Storage screen.

VIEW STORAGE	2056
16:20:03	15-Jun-04
>01-Hr MC	34.9
24-Hr MC	12.3

Figure A-22. View Storage screen with additional lines displayed.

VIEW STORAGE	2056
16:20:03	15-Jun-04
>01-Hr MC	34.9
24-Hr MC	12.3
Main Flow	3.0
Frequency	248.3217
Noise	5.438
Null	0
Null	0
Null	0

Figure A-23. Set Storage screen.

```
      SET STORAGE
Stor Var1      > 01-Hr MC
Stor Var2        24-Hr MC
Stor Var3        Samp Dew
```

Figure A-24. Set Storage screen with additional lines displayed.

```
      SET STORAGE
Stor Var1      > 01-Hr MC
Stor Var2        24-Hr MC
Stor Var3        Samp Dew
Stor Var4       Frequency
Stor Var5        Tot Mass
Stor Var6        Amb Temp
Stor Var7            Null
Stor Var8            Null
Interval            60.00
Stor Vars               4
Station          48048048
```

Figure A-25. Set Temps/ Flows screen.

```
      SET TEMPS/FLOWS
T-Case>    30.00    30.00
T-Air      30.00    30.00
T-Cap      30.00    29.98
```

Figure A-26. Set Temps/ Flows screen with additional lines displayed.

```
      SET TEMPS/FLOWS
T-Case>    30.00    30.00
T-Air      30.00    30.00
T-Cap      30.00    29.98
---------------------------
F-Main      3.00     3.00
F-Aux      13.67    13.65
T-A/S      25.00    25.00
P-A/S      1.000    1.000
Amb Temp             23.4
Amb Pres            0.988
FAdj Main           1.000
FAdj Aux            1.000
```

Figure A-27. Set Hardware screen.

```
        SET HARDWARE
Cal Const>              9605
Ser Num                22822
Wait Time               1800
```

Figure A-28. Set Hardware screen with additional lines displayed.

```
        SET HARDWARE
Cal Const>              9605
Ser Num                22822
Wait Time               1800
----------------------------
Gate Time                  5
XX-Hr MC                   8
Soft Rate           0.000000
Hard Rate           0.000000
Version                3.016
Mass Avg                 360
```

Figure A-29. View Analog Inputs screen.

```
    VIEW ANALOG INPUTS
A/I 0       >       0.000
A/I 1              17.363
A/I 2              27.463
```

Figure A-30. View Analog Inputs screen with additional lines displayed.

```
    VIEW ANALOG INPUTS
A/I 0>              0.000
A/I 1              17.363
A/I 2              27.463
-------------------------
A/I 3              15.957
A/I 4               1.640
A/I 5               2.983
A/I 6              41.885
```

Figure A-31. Define Analog Inputs screen.

```
DEFINE A/I              0
A/I %FS  >           4.83
A/I Type        Mass Conc
Const A             0.000
```

Figure A-32. Define Analog Inputs screen with additional lines displayed.

```
DEFINE A/I              0
A/I %FS  >           4.83
A/I Type        Mass Conc
Const A             0.000
-------------------------
Const B             1.000
Const C             0.000
A/I Ave             0.000
```

Figure A-33. Set Password screen.

```
      SET PASSWORD
Cur Lo Pass>           *
New Lo Pass            *
Cur Hi Pass            *
```

Figure A-34. Set Password screen with additional lines displayed.

```
      SET PASSWORD
Cur Lo Pass>           *
New Lo Pass            *
Cur Hi Pass            *
-------------------------
New Hi Pass            *
```

Figure A-35. Analog Calibration screen.

```
   ANALOG CALIBRATION
Calibrate       >    YES
A/O Value          50.00
A/I Channel     6  50.00
```

Figure A-36. K0 Confirmation screen.

```
K0 Confirm     209.44188
>Filt Wght       0.07903
 287.53182     209.44186
 Audit K0           9683
```

Figure A-37. K0 Confirmation screen with additional lines displayed.

```
K0 Confirm     209.44188
>Filt Wght       0.07903
 287.53182     209.44186
 Audit K0           9683
-------------------------
 Actual K0          9627
 % Diff             0.58
```

Figure A-38. FTS Calculation screen.

```
FTS Calculation
Manometer      > 5.009788
Mano B            -0.1724
Mano M             0.3570
```

Figure A-39. FTS Calculation screen with additional lines displayed.

```
FTS Calculation
Manometer      > 5.009788
Mano B            -0.1724
Mano M             0.3570
-------------------------
FTS Flow            0.000
Amb Temp             23.4
Amb Pres            0.987
```

Figure A-40. Mass concentration screen.

```
 Mass Concentration
Curr Chan           BASE
Mass Conc           11.5
Base MC             10.3
```

Figure A-41. Mass concentration screen with additional lines displayed.

```
 Mass Concentration
Curr Chan           BASE
Mass Conc           11.5
Base MC             10.3
------------------------
Ref MC              -1.2
```

A.2. RPComm Software Screens

This appendix contains all of the software screens displayed by the RPComm software program.

Figure A-42. Connection List screen.

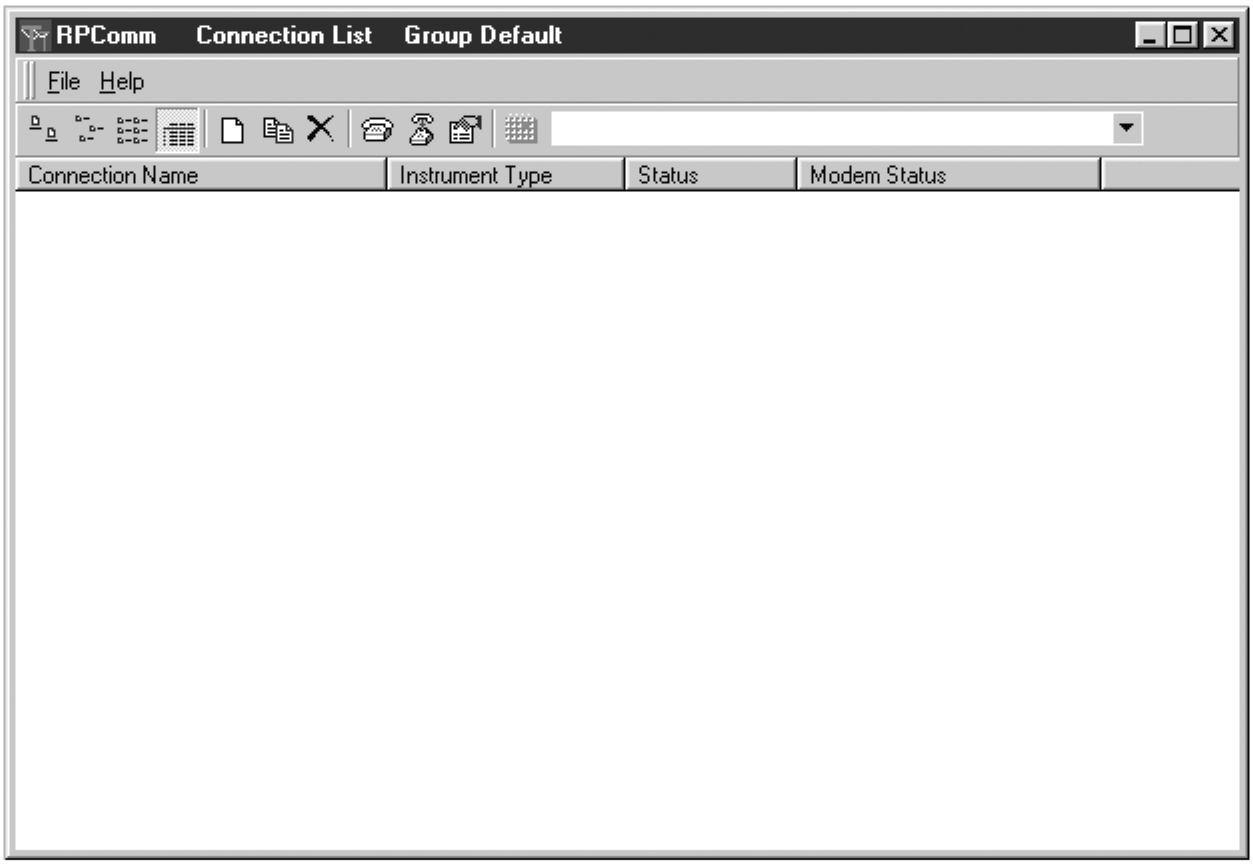
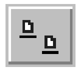
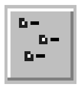
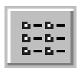
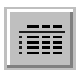
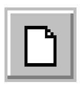
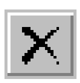
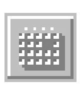
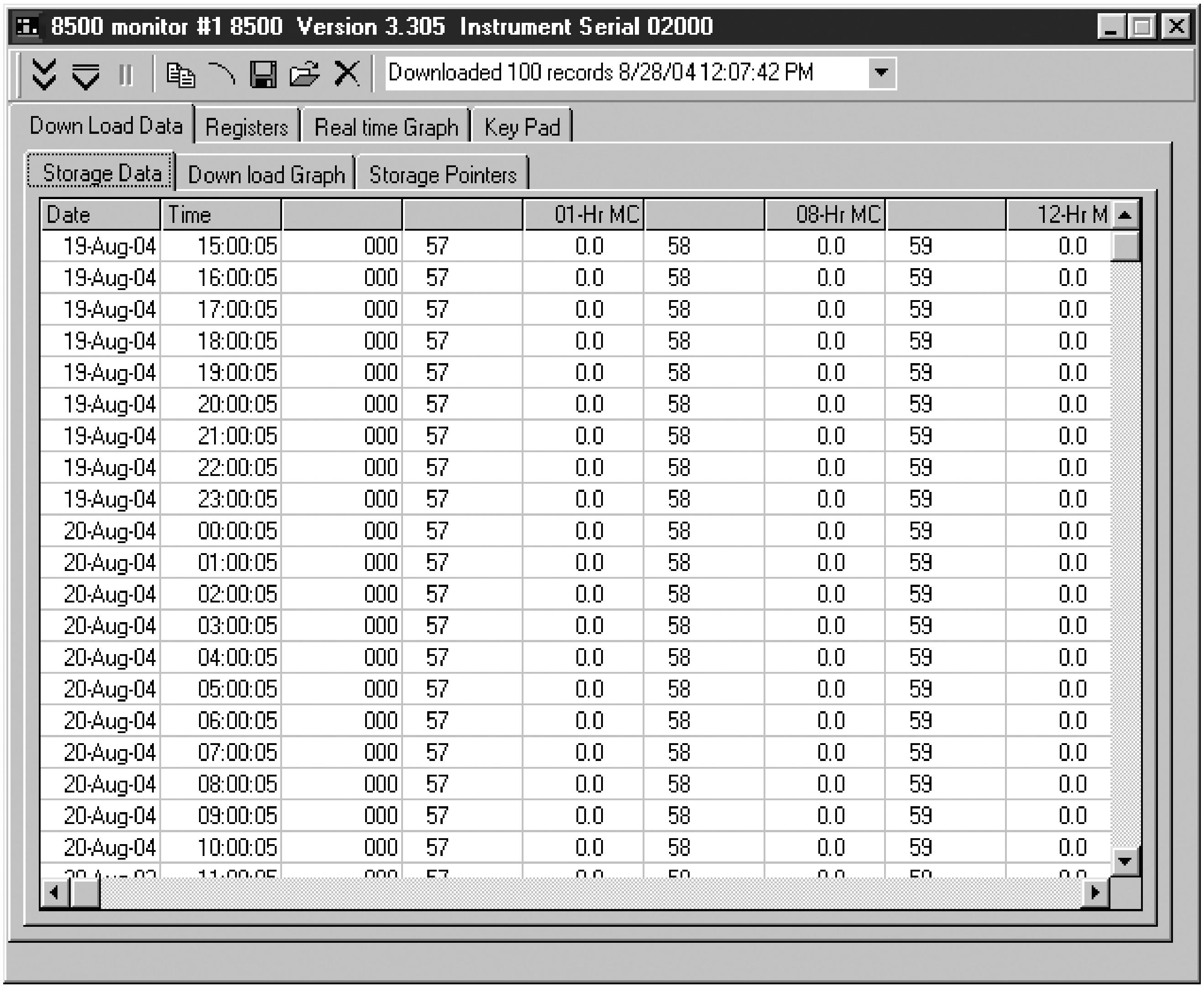


Figure A-43. Control buttons on the Connection List screen.

	Displays the instrument connections on the screen as large icons.
	Displays the instrument connections on the screen as small icons.
	Displays the instrument connections on the screen as a list.
	Displays the instrument connections on the screen as a list with details such as instrument type and status.
	Creates a new instrument connection.
	Edits the settings of the instrument connection currently selected.
	Deletes the instrument connection currently selected.
	Establishes a connection to the selected instrument.
	Disconnects the instrument connection.
	Displays the Properties screen showing the connection properties for the selected instrument.
	Displays the Schedule Download screen which allows the user to schedule automatic data downloads from the selected instrument.

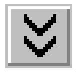
Contains a list of the data downloads currently scheduled.

Figure A-44. Download Data screen.



Date	Time			01-Hr MC		08-Hr MC		12-Hr M
19-Aug-04	15:00:05	000	57	0.0	58	0.0	59	0.0
19-Aug-04	16:00:05	000	57	0.0	58	0.0	59	0.0
19-Aug-04	17:00:05	000	57	0.0	58	0.0	59	0.0
19-Aug-04	18:00:05	000	57	0.0	58	0.0	59	0.0
19-Aug-04	19:00:05	000	57	0.0	58	0.0	59	0.0
19-Aug-04	20:00:05	000	57	0.0	58	0.0	59	0.0
19-Aug-04	21:00:05	000	57	0.0	58	0.0	59	0.0
19-Aug-04	22:00:05	000	57	0.0	58	0.0	59	0.0
19-Aug-04	23:00:05	000	57	0.0	58	0.0	59	0.0
20-Aug-04	00:00:05	000	57	0.0	58	0.0	59	0.0
20-Aug-04	01:00:05	000	57	0.0	58	0.0	59	0.0
20-Aug-04	02:00:05	000	57	0.0	58	0.0	59	0.0
20-Aug-04	03:00:05	000	57	0.0	58	0.0	59	0.0
20-Aug-04	04:00:05	000	57	0.0	58	0.0	59	0.0
20-Aug-04	05:00:05	000	57	0.0	58	0.0	59	0.0
20-Aug-04	06:00:05	000	57	0.0	58	0.0	59	0.0
20-Aug-04	07:00:05	000	57	0.0	58	0.0	59	0.0
20-Aug-04	08:00:05	000	57	0.0	58	0.0	59	0.0
20-Aug-04	09:00:05	000	57	0.0	58	0.0	59	0.0
20-Aug-04	10:00:05	000	57	0.0	58	0.0	59	0.0

Figure A-45. Control buttons on the Download Data screen.

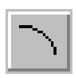


Downloads all stored data in the data buffer, starting at the first data record. After the data are downloaded, the storage pointer will move to the end of the data storage buffer. When the data have been downloaded, the data will be displayed in the Download Data screen.

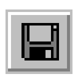
Downloads data from the current storage pointer position to the end of the data buffer. After the data are downloaded, the storage pointer will move to the end of the data storage buffer.

Aborts the download. This action will set the storage pointer to the record location where the download was aborted.

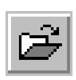
Copies the selected data to the Windows clipboard. The data can then be imported and used in other programs.



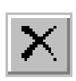
Sends the selected data to the Download Graph screen.



Stores the data to a file. The file is saved in a comma-delimited ASCII format.



Opens a data file that has been previously saved to disk for display or graphing.



Clears the data currently being displayed.

When the download has been successfully completed, a message will appear in the Dialog box indicating how many records were downloaded.

Figure A-46. Download Graph screen.

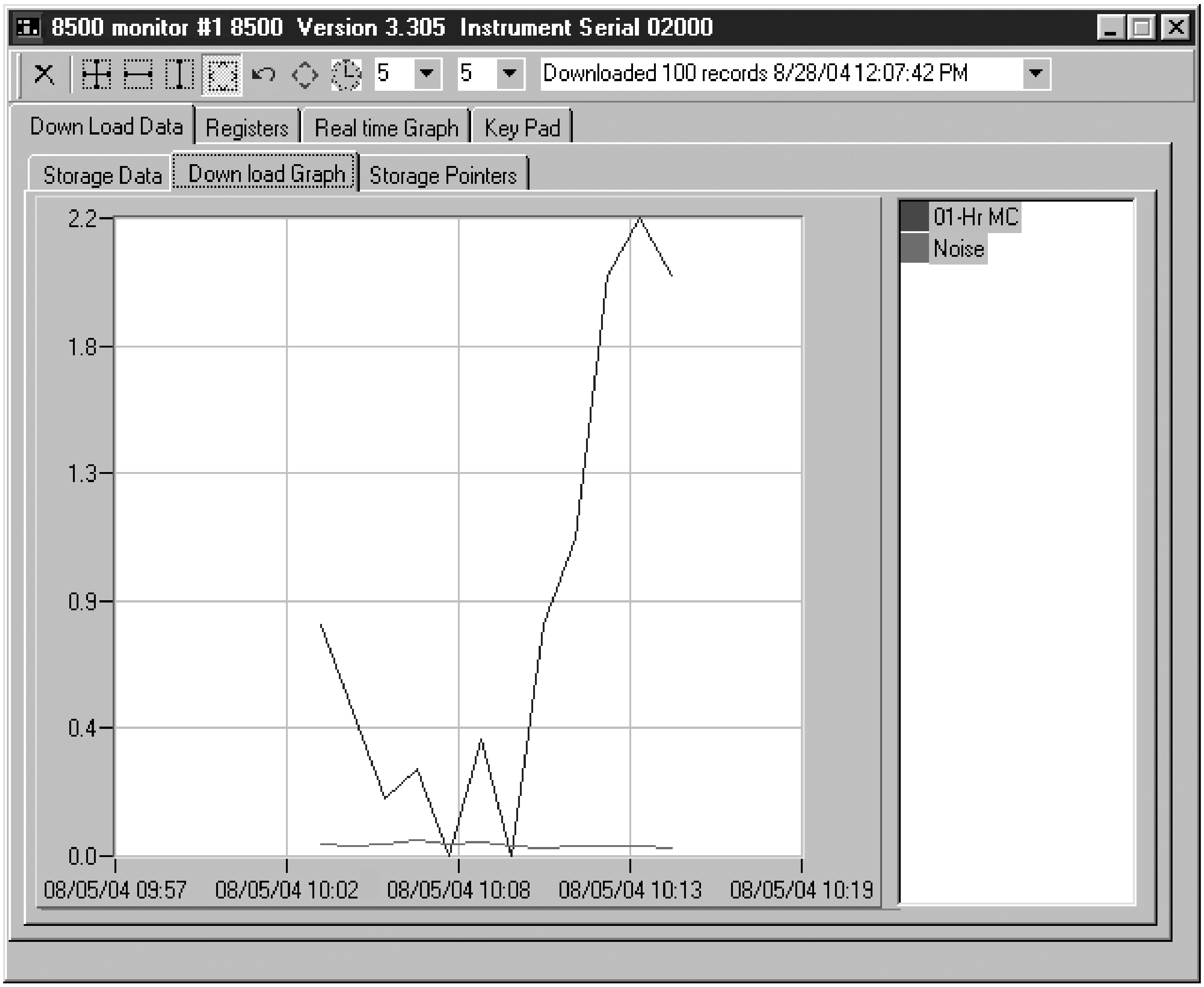
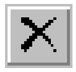
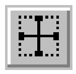
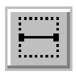
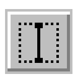


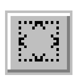
Figure A-47. Control buttons on the Download Graph screen.

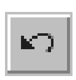

Clears all data listed on the right-hand side of the Download Graph screen. This includes the data being displayed.

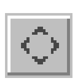

Decreases the scale of the x- and y-axes concurrently. With this icon selected, press and hold the left mouse button and make a box around an area (inside the graph) that you want to zoom into. Once the box is finished, release the mouse button. The graph will be resized according to the box dimensions.

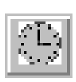

Decreases the scale of the x-axis. With this icon selected, press and hold the left mouse button at the beginning of the area that you want to zoom into. Drag the cursor horizontally to the end of the zoom area and release the mouse button. The graph will be resized according to the new x-axis dimensions.

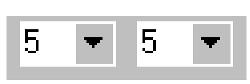

Decreases the scale of the y-axis. With this icon selected, press and hold the left mouse button at the beginning of the area that you want to zoom into. Drag the cursor vertically to the end of the zoom area and release the mouse button. The graph will be resized according to the new y-axis dimensions.


Enables panning. Panning allows the user to move the graph area so that a different section of the x- or y-axis will be displayed without effecting the scale of either axis. With this icon selected, place the mouse cursor somewhere within the graph area and hold down the left mouse button. Move the mouse to display the desired section of the graph.


Selecting this icon will undo the last zoom or panning step.


Rescales the x- and y-axes so that all the graphs for the selected data are displayed.


Toggles between the two possible x-axis scales: date and time, and time only. This does not affect the way the data are displayed on the graph.



These two boxes define the number of axis divisions on the graph. The left box refers to the x axis and the right box refers to the y axis. The number of divisions on the axis can be set to 5, 10, 15 or 20. Increasing the number of divisions results in a finer axis grid. Decreasing the number of divisions results in a courser axis grid. This does not affect the way the data are displayed on the graph.

Figure A-48. Storage Pointer screen.

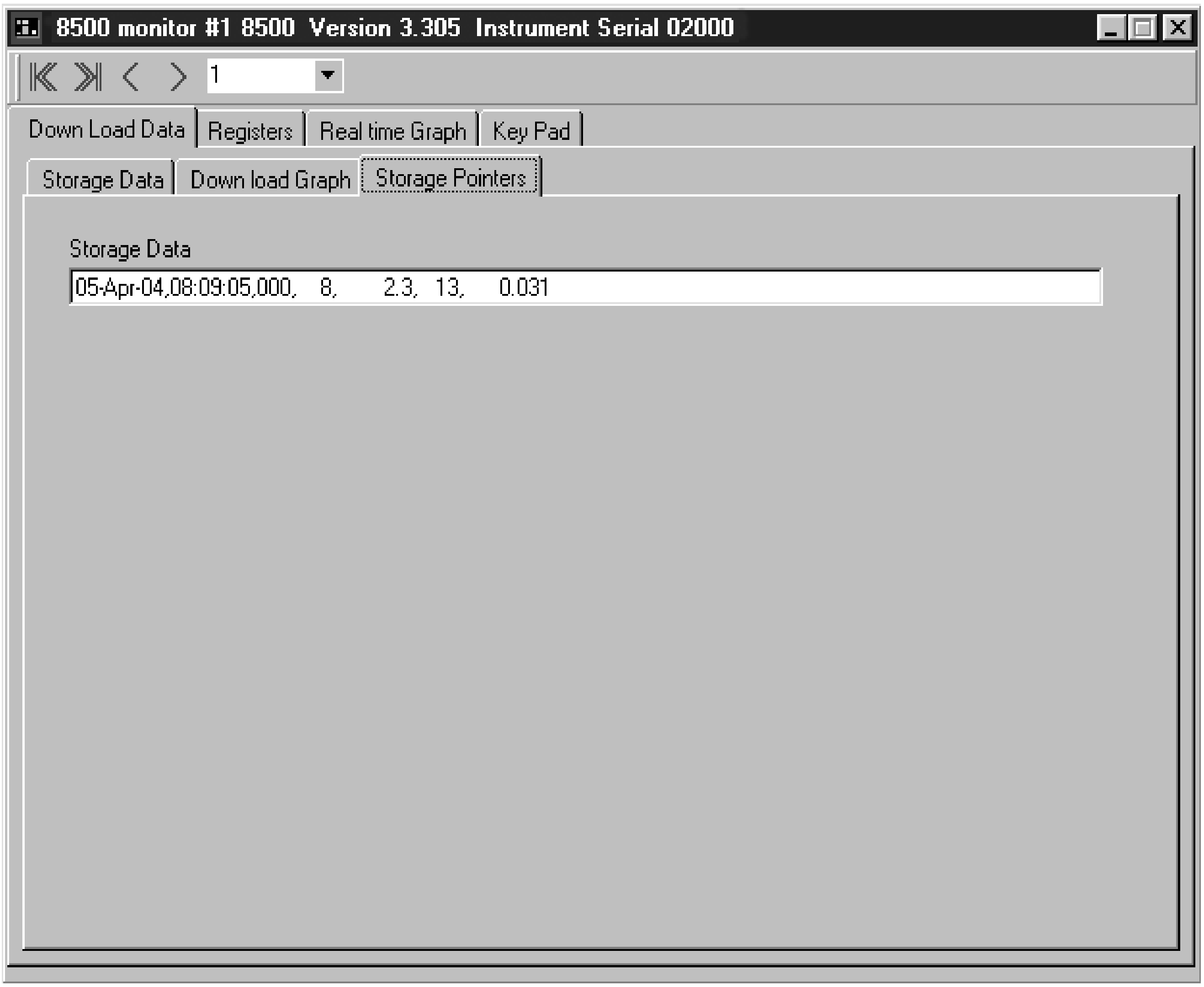
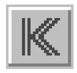
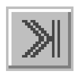


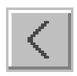
Figure A-49. Control buttons on the Storage Pointer screen.



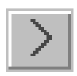
Moves the storage pointer to the first record in the buffer. The displayed position of the storage pointer will change, unless the storage pointer was already at the beginning of the buffer.



Moves the storage pointer to the last record in the buffer. The displayed position of the storage pointer will change, unless the storage pointer was already at the end of the buffer.



Moves the storage pointer back “x” number of records, where “x” is defined in the Change Record Step box



Moves the storage pointer forward “x” number of records, where “x” is defined in the Change Record Step box.

Change Record Step box. The step size can be 1, 5, 10, 100 or 1000.

Figure A-50. Registers screen.

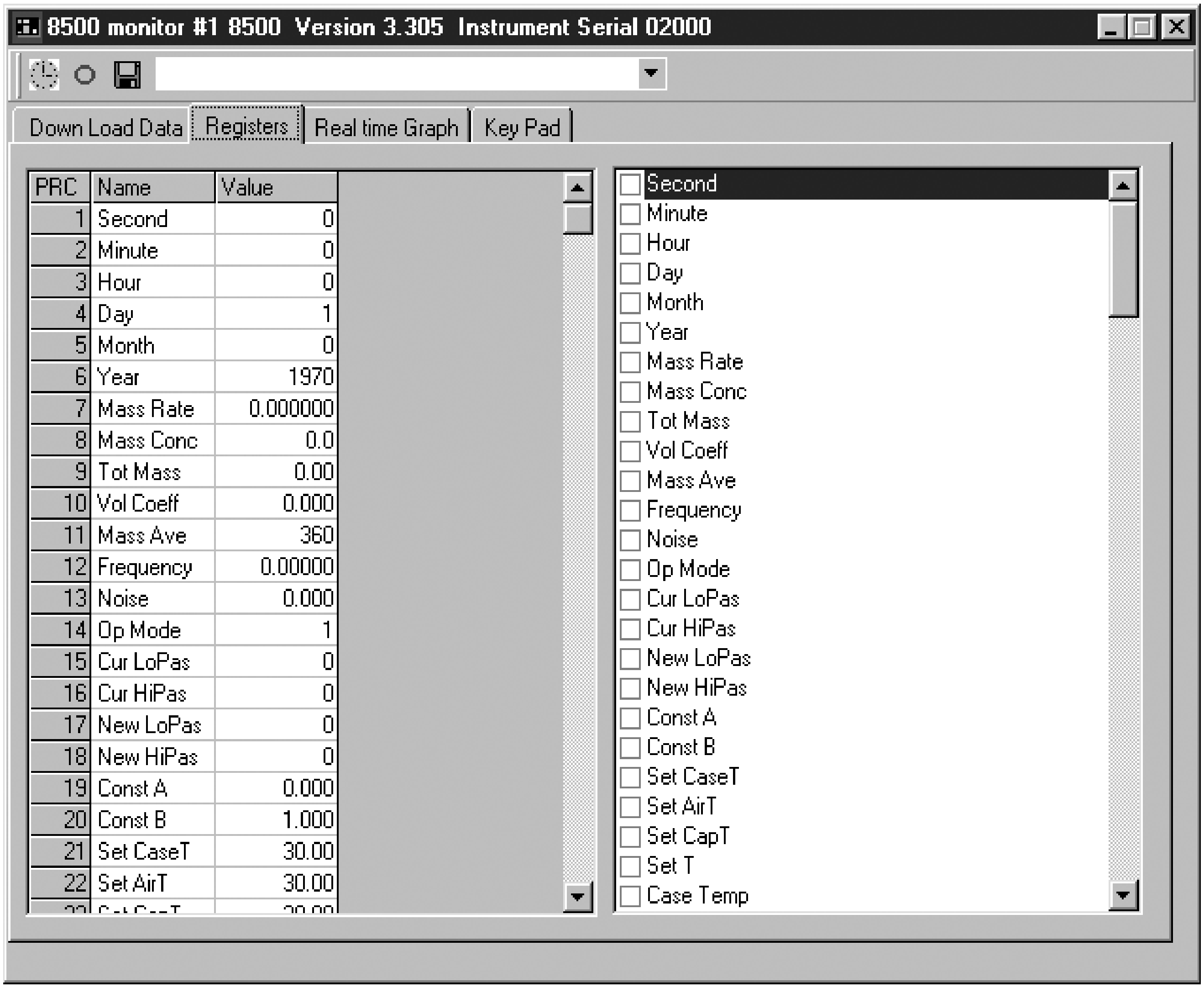


Figure A-51. Control buttons on the Registers screen.

Reads selected register values from the unit.

Selects all registers.

Saves register data to a file.

Figure A-52. Real-Time Graph screen.

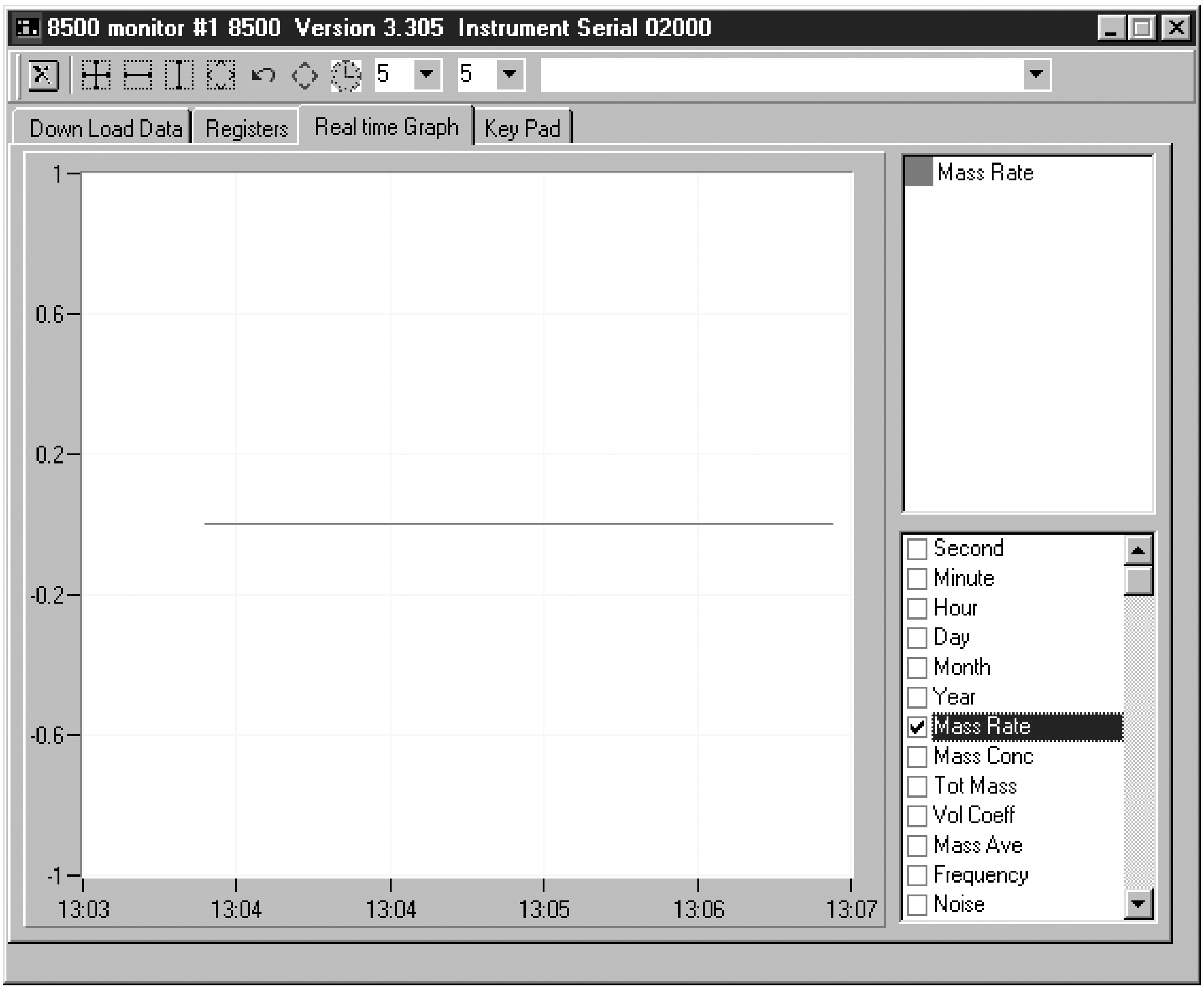
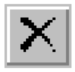
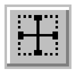
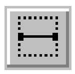
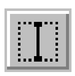


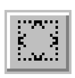
Figure A-53. Control buttons on the Real-Time Graph screen.

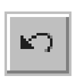

Clears all data listed on the right-hand side of the Real-Time Graph screen. This includes the data being displayed.

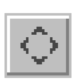

Decreases the scale of the x- and y-axes concurrently. With this icon selected, press and hold the left mouse button and make a box around an area (inside the graph) that you want to zoom into. Once the box is finished, release the mouse button. The graph will be resized according to the box dimensions.

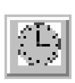

Decreases the scale of the x-axis. With this icon selected, press and hold the left mouse button at the beginning of the area that you want to zoom into. Drag the cursor horizontally to the end of the zoom area and release the mouse button. The graph will be resized according to the new x-axis dimensions.


Decrease the scale of the y-axis. With this icon selected, press and hold the left mouse button at the beginning of the area that you want to zoom into. Drag the cursor vertically to the end of the zoom area and release the mouse button. The graph will be resized according to the new y-axis dimensions.


Enables panning. Panning allows the user to move the graph so that a different section of the x- or y-axis will be displayed without effecting the scale of either axis. With this icon selected, place the mouse cursor somewhere within the graph area and hold down the left mouse button. Move the mouse to display the desired section of the graph.

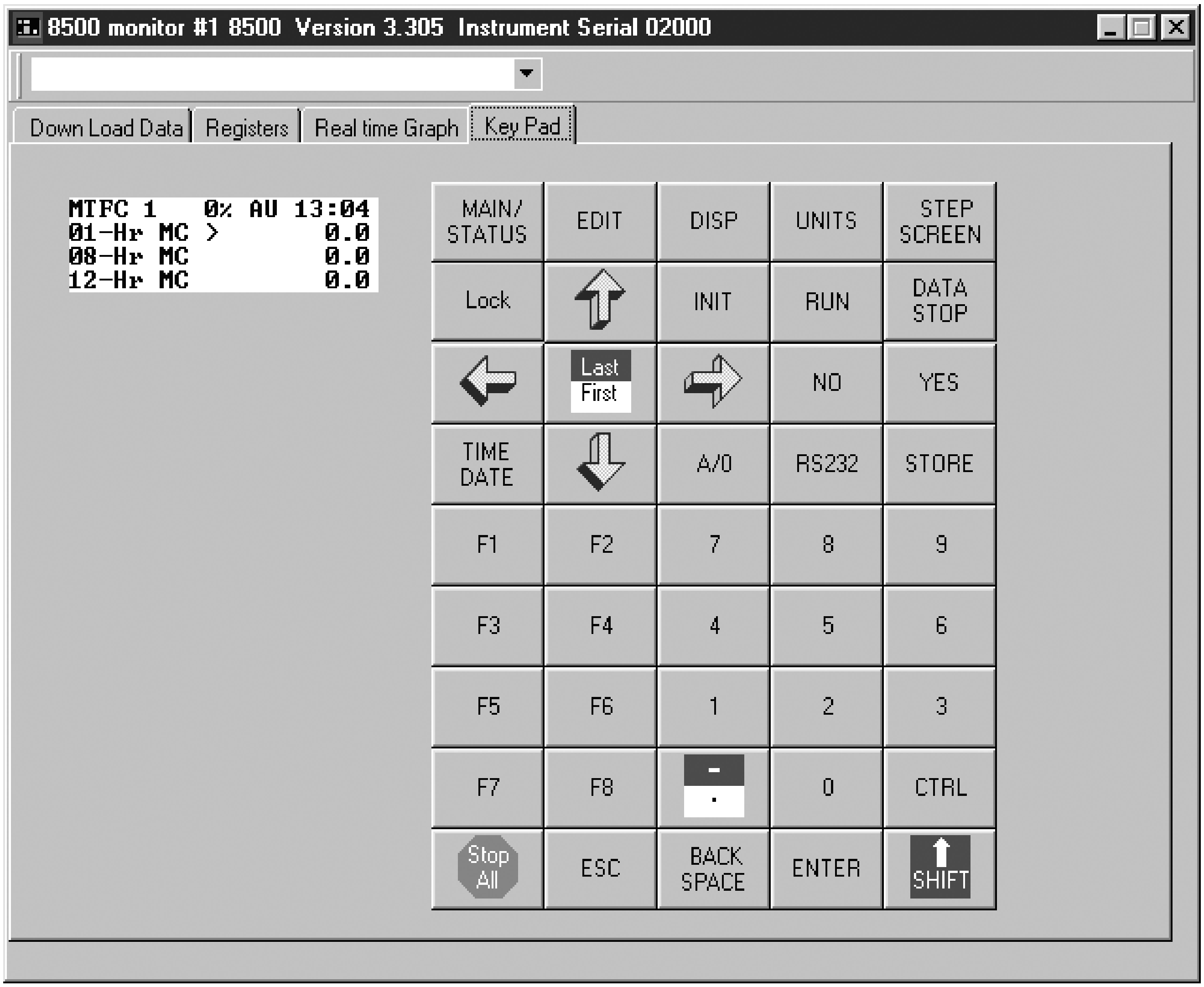

Selecting this icon will undo the last zoom or panning step.


Rescales the x- and y-axes so that all the graphs for the selected data are displayed.


Toggles between the two possible x-axis scales: date and time, and time only. This does not affect the way the data are displayed on the graph.

These two boxes define the number of axis divisions on the graph. The left-hand box refers to the x-axis and the right-hand box refers to the y-axis. The number of divisions on the axis can be set to 5, 10, 15 or 20. Increasing the number of divisions results in a finer axis grid. Decreasing the number of divisions results in a courser axis grid. This does not affect the way the data are displayed on the graph.

Figure A-54. Virtual keypad.



A.3. TEOMCOMM Software Screens

This appendix contains all of the software screens displayed by the TEOMCOMM software program.

Figure A-55. Main screen.

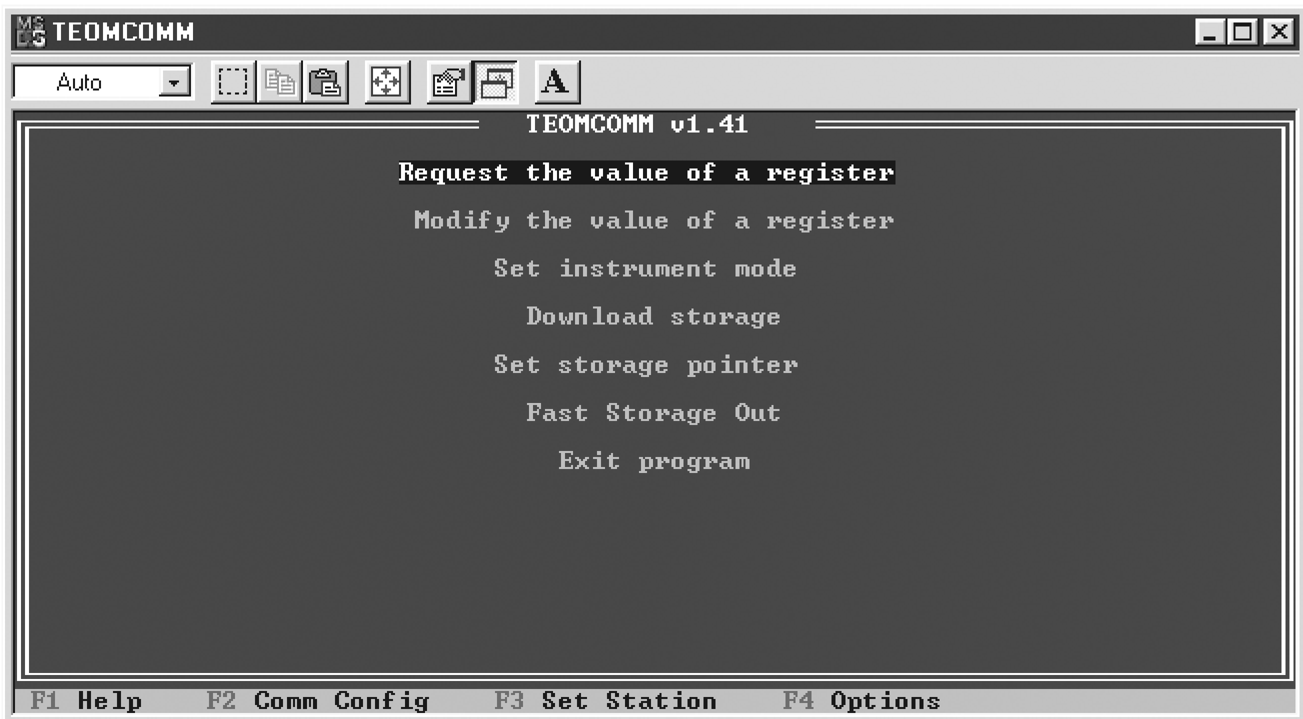


Figure A-56. Communications Setup screen.

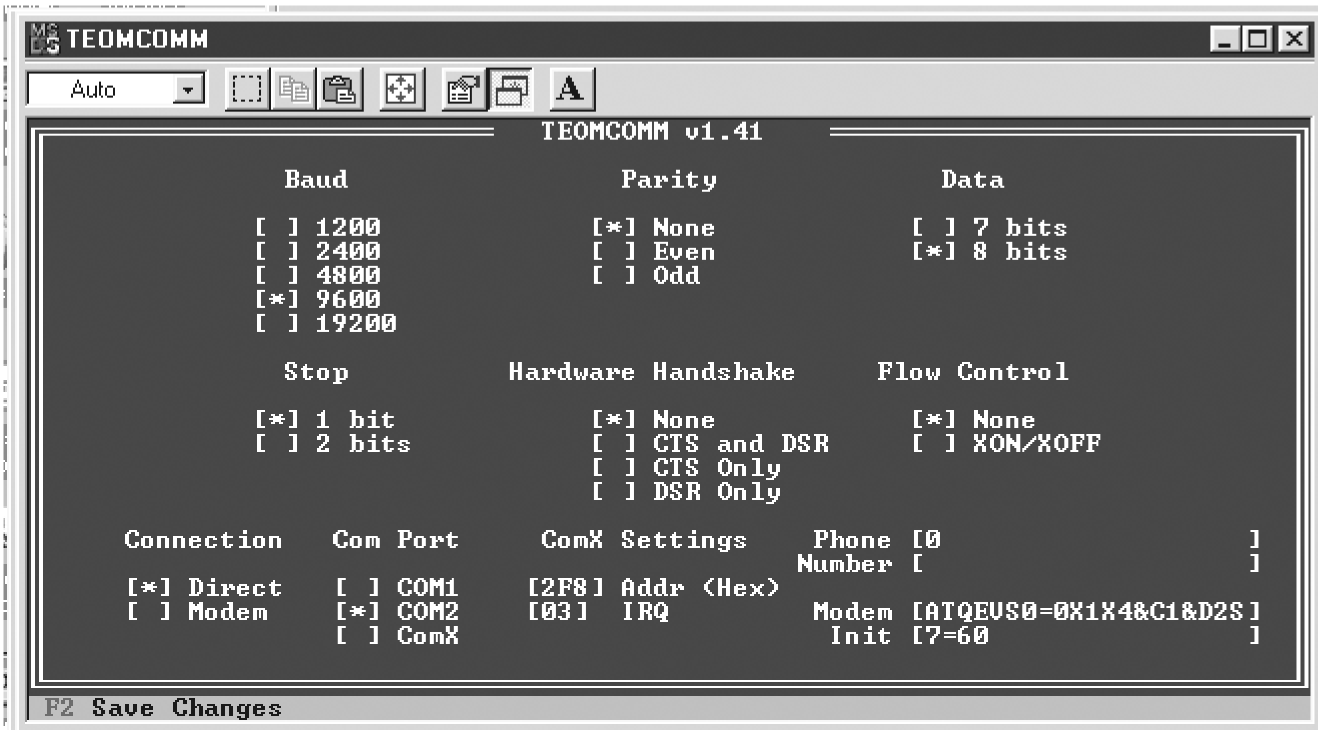


Figure A-57. Send String screen.

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Appendix B: Program Register Codes

This appendix contains a list of the Program Register Codes (PRC) used by the instrument. These codes are numbers that represent variables used by the monitor.

B.1. Program Register Codes

MAIN PROGRAM REGISTER CODES						
Code	**Description**	**Units**	**Range**	**Default**	**Re-Init**	**Edit Modes**
007	Mass Rate	µg/hour	N/A	N/A	N/A	not editable
008	Mass Concentration	µg/m³	N/A	N/A	N/A	not editable
012	Frequency	hz	N/A	N/A	N/A	not editable
013	Noise	µg	N/A	N/A	N/A	not editable
014	Operating Mode, 0(S), 1, 2, 3, 4, 5(X)	code*	0 - 5	N/A	N/A	not editable
025	Current Case Temperature	°C	N/A	N/A	N/A	not editable
026	Current Air Temperature	°C	N/A	N/A	N/A	not editable
027	Current Cap Temperature	°C	N/A	N/A	N/A	not editable
035	Filter Loading, percent of filter lifetime used	%	0 - 100	N/A	N/A	not editable
039	Current Main Flow	l/min	N/A	N/A	N/A	not editable
040	Current Auxiliary Flow	l/min	N/A	N/A	N/A	not editable
041	Status Condition	code*	N/A	N/A	N/A	not editable
057	1-Hour Average Mass Concentration	µg/m³	N/A	N/A	N/A	not editable
058	XX-Hour Average Mass Concentration	µg/m³	N/A	N/A	N/A	not editable
059	12-Hour Average Mass Concentration	µg/m³	N/A	N/A	N/A	not editable
060	24-Hour Average Mass Concentration	µg/m³	N/A	N/A	N/A	not editable
063	Serial Number	N/A	N/A	N/A	N/A	not editable
099	Sample Dew Point	°C	N/A	N/A	N/A	not editable
100	Ambient Relative Humidity	%	N/A	N/A	N/A	not editable
102	Base MC	µg/m³	N/A	N/A	N/A	not editable
104	Reference MC	µg/m³	N/A	N/A	N/A	not editable
114	Ambient Dew Point	°C	N/A	N/A	N/A	not editable
123	Current Ambient Temperature	°C	N/A	N/A	N/A	not editable
124	Current Ambient Pressure	atm	N/A	N/A	N/A	not editable
* Codes are described later in this Appendix.						

PROGRAM REGISTER CODES (000-024)						
Code	**Description**	**Units**	**Range**	**Default**	**Re-Init**	**Edit Modes**
000	Null	N/A	N/A	N/A	N/A	not editable
001	Second, used for setting time/date	sec	0 - 59	N/A	N/A	S
002	Minute, used for setting time/date	min	0 - 59	N/A	N/A	S
003	Hour, used for setting time/date	hour	0 - 23	N/A	N/A	S
004	Day, used for setting time/date	day	1 - 31	N/A	N/A	S
005	Month, used for setting time/date (0 = Jan)	month	0 - 11	N/A	N/A	S
006	Year, used for setting time/date	year	1,970 - 2,106	N/A	N/A	S
007	Mass Rate	µg/hr	N/A	N/A	N/A	not editable
008	Mass Concentration	µg/m³	N/A	N/A	N/A	not editable
009	Total Mass	µg	N/A	N/A	N/A	not editable
010	Val 1 (Internal use only)	N/A	N/A	N/A	N/A	not editable
011	Mass Averaging Time	sec	N/A	360	360	not editable
012	Frequency, current oscillating frequency	hz	N/A	N/A	N/A	not editable
013	Noise, diagnostic measurement	µg	N/A	N/A	N/A	not editable
014	Operating Mode, 0(S), 1, 2, 3, 4, 5(X)	code*	0 - 5	N/A	N/A	not editable
015	Cur Low Pass, used to set new password	N/A	N/A	100,000	N/A	1, 2, 3, 4, S, X
016	Cur High Pass, used to set new password	N/A	N/A	100,000	N/A	1, 2, 3, 4, S, X
017	New Low Pass, used to set new password	N/A	N/A	N/A	N/A	1, 2, 3, 4, S, X
018	New High Pass, used to set new password	N/A	N/A	N/A	N/A	1, 2, 3, 4, S, X
019	Const A, used in MC conversion formula	N/A	-100 - 100	3	3	S
020	Const B, used in MC conversion formula	N/A	0.25 - 4	1.03	1.03	S
021	Case Temperature Set Point	°C	30 - 40	30	30	S
022	Air Temperature Set Point	°C	30 - 40	30	30	S
023	Cap Temperature Set Point	°C	30 - 40	30	30	S
024	Enclosure Set Point (not used)	N/A	N/A	N/A	N/A	not editable
* Codes are decribed later in this Appendix.						

PROGRAM REGISTER CODES (025-049)						
Code	**Description**	**Units**	**Range**	**Default**	**Re-Init**	**Edit Modes**
025	Current Case Temperature	°C	N/A	N/A	N/A	not editable
026	Current Air Temperature	°C	N/A	N/A	N/A	not editable
027	Current Cap Temperature	°C	N/A	N/A	N/A	not editable
028	Current Enclosure Temperature (not used)	N/A	N/A	N/A	N/A	not editable
029	Average Temperature, used in flow calculations	°C	-40 - 75	25	25	S
030	Standard Temperature, used in flow calculations	°C	-40 - 75	25	25	S
031	Average Pressure, used in flow calculations	atm	0.5 - 3	1	1	S
032	Standard Pressure, used in flow calculations	atm	0.5 - 3	1	1	S
033	Main Flow Adjustment, software flow calibration	factor	0.8 - 1.2	1	1	S
034	Auxiliary Flow Adjustment, software flow calibration	factor	0.8 - 1.2	1	1	S
035	Filter Loading, percentage of filter used	%	0 - 100	N/A	N/A	not editable
036	Wait Time, temp/flow stabilization period	sec	0 - 99999	1800	1800	1, 2, 3, 4, S, X
037	Main Flow Set Point	l/min	0.5 - 5	3	3	S
038	Auxiliary Flow Set Point	l/min	2 - 20	13.67	13.67	S
039	Current Main Flow	l/min	N/A	N/A	N/A	not editable
040	Current Auxiliary Flow	l/min	N/A	N/A	N/A	not editable
041	Status Condition	code*	N/A	N/A	N/A	not editable
042	Calibration Constant, K_0 - unique for each monitor	N/A	N/A	N/A	N/A	not editable
043	Current RS-232 Mode	code*	N/A	0	N/A	1, 2, 3, 4, S, X
044	Instrument Station Code	N/A	N/A	000	000	1, 2, 3, 4, S, X
045	Print Interval	sec	5 - 32767	1800	1800	1, 2, 3, 4, S, X
046	Print Columns	N/A	1 - 6	6	6	1, 2, 3, 4, S, X
047	Print Variable 1	PRC	PRC Range	8	8	1, 2, 3, 4, S, X
048	Print Variable 2	PRC	PRC Range	57	57	1, 2, 3, 4, S, X
049	Print Variable 3	PRC	PRC Range	58	58	1, 2, 3, 4, S, X
* Codes are described later in this Appendix.						

PROGRAM REGISTER CODES (050-074)						
Code	**Description**	**Units**	**Range**	**Default**	**Re-Init**	**Edit Modes**
050	Print Variable 4	PRC	PRC Range	60	60	1, 2, 3, 4, S, X
051	Print Variable 5	PRC	PRC Range	9	9	1, 2, 3, 4, S, X
052	Print Variable 6	PRC	PRC Range	0	0	1, 2, 3, 4, S, X
053	RS-232 Parameter 1	N/A	N/A	52	N/A	1, 2, 3, 4, S, X
054	RS-232 Parameter 2	N/A	N/A	75048	N/A	1, 2, 3, 4, S, X
055	RS-232 Parameter 3	N/A	N/A	13010	N/A	1, 2, 3, 4, S, X
056	RS-232 Parameter 4	N/A	N/A	0	N/A	1, 2, 3, 4, S, X
057	1-Hour Average MC, updated every hour	$\mu g/m^3$	N/A	N/A	N/A	not editable
058	XX-Hour Average MC, updated every hour	$\mu g/m^3$	N/A	N/A	N/A	not editable
059	12-Hour Average MC, updated every hour	$\mu g/m^3$	N/A	N/A	N/A	not editable
060	24-Hour Average MC, updated every hour	$\mu g/m^3$	N/A	N/A	N/A	not editable
061	Protection Level	code*	N/A	N/A	N/A	not editable
062	Current Time/Date, seconds since 01-01-70	sec	N/A	N/A	N/A	not editable
063	Serial Number	N/A	N/A	N/A	N/A	1, 2, 3, 4, S, X
064	Software Version	N/A	N/A	N/A	N/A	not editable
065	Maximum Analog Voltage	code*	0 - 3	3	N/A	1, 2, 3, 4, S, X
066	Analog Output 1 Variable	PRC	PRC Range	57	57	1, 2, 3, 4, S, X
067	Analog Output 1 Minimum	N/A	N/A	0	0	1, 2, 3, 4, S, X
068	Analog Output 1 Maximum	N/A	N/A	500	500	1, 2, 3, 4, S, X
069	Analog Output 2 Variable	PRC	PRC Range	58	58	1, 2, 3, 4, S, X
070	Analog Output 2 Minimum	N/A	N/A	0	0	1, 2, 3, 4, S, X
071	Analog Output 2 Maximum	N/A	N/A	500	500	1, 2, 3, 4, S, X
072	Analog Output 3 Variable	PRC	PRC Range	9	9	1, 2, 3, 4, S, X
073	Analog Output 3 Minimum	N/A	N/A	0	0	1, 2, 3, 4, S, X
074	Analog Output 3 Maximum	N/A	N/A	5000	5000	1, 2, 3, 4, S, X

* Codes are described later in this Appendix.

PROGRAM REGISTER CODES (075-099)						
Code	**Description**	**Units**	**Range**	**Default**	**Re-Init**	**Edit Modes**
075	Analog Output Jumper Setting	code*	0 - 1	1	N/A	1, 2, 3, 4, S, X
076	Storage Interval	sec	0.1 - 86400	1800	1800	1, 2, 3, 4, S, X
077	Storage Variable 1	PRC	PRC Range	57	57	1, 2, 3, 4, S, X
078	Storage Variable 2	PRC	PRC Range	58	58	1, 2, 3, 4, S, X
079	Storage Variable 3	PRC	PRC Range	59	59	1, 2, 3, 4, S, X
080	Storage Variable 4	PRC	PRC Range	60	60	1, 2, 3, 4, S, X
081	Storage Variable 5	PRC	PRC Range	9	9	1, 2, 3, 4, S, X
082	Storage Variable 6	PRC	PRC Range	0	0	1, 2, 3, 4, S, X
083	Storage Variable 7	PRC	PRC Range	0	0	1, 2, 3, 4, S, X
084	Storage Variable 8	PRC	PRC Range	0	0	1, 2, 3, 4, S, X
085	Storage Variables (change erases data storage!)	N/A	0 - 8	8	0	1, 2, 3, 4, S, X
086	Storage Value 1	N/A	N/A	N/A	N/A	not editable
087	Storage Value 2	N/A	N/A	N/A	N/A	not editable
088	Storage Value 3	N/A	N/A	N/A	N/A	not editable
089	Storage Value 4	N/A	N/A	N/A	N/A	not editable
090	Storage Value 5	N/A	N/A	N/A	N/A	not editable
091	Storage Value 6	N/A	N/A	N/A	N/A	not editable
092	Storage Value 7	N/A	N/A	N/A	N/A	not editable
093	Storage Value 8	N/A	N/A	N/A	N/A	not editable
094	Analog Calibration Mode, 0:Off, 1:On	code*	0 - 1	0	0	S
095	Analog Calibration Input Channel	N/A	0 - 15	0	0	S
096	Analog Calibration Input, % of full scale	%	0 - 100	0	0	not editable
097	Analog Calibration Output, % of full scale	%	0 - 100	0	0	S
098	Currently Active Channel	N/A	0 - 8	N/A	N/A	not editable
099	Sample Dew Point	°C	N/A	N/A	N/A	not editable

* Codes are described later in this Appendix.

PROGRAM REGISTER CODES (100-124)						
Code	**Description**	**Units**	**Range**	**Default**	**Re-Init**	**Edit Modes**
100	Ambient Relative Humidity	%	N/A	N/A	N/A	not editable
101	Raw Frequency	hz	N/A	N/A	N/A	not editable
102	Base Mass Concentration (Base MC)	$\mu g/m^3$	N/A	N/A	N/A	not editable
103	Frequency Gate Time	sec	2 - 60	10	10	S
104	Reference Mass Concentration (Ref MC)	$\mu g/m^3$	N/A	N/A	N/A	not editable
105	Val 2 (Internal use only)	N/A	N/A	N/A	N/A	not editable
106	Val 3 (Internal use only)	N/A	N/A	N/A	N/A	not editable
107	Analog Input 0	N/A	N/A	N/A	N/A	not editable
108	Analog Input 1	N/A	N/A	N/A	N/A	not editable
109	Analog Input 2	N/A	N/A	N/A	N/A	not editable
110	Analog Input 3	N/A	N/A	N/A	N/A	not editable
111	Analog Input 4	N/A	N/A	N/A	N/A	not editable
112	Analog Input 5	N/A	N/A	N/A	N/A	not editable
113	Analog Input 6	N/A	N/A	N/A	N/A	not editable
114	Ambient Dew Point	°C	N/A	N/A	N/A	not editable
115	FTS Flow, Calculated Volumetric Flow	l/min	N/A	N/A	N/A	not editable
116	Calibration Filter Weight	g	0 - 100	N/A	N/A	1,2,3,4,S,X
117	Frequency 0 (Mass Calibration Verification)	hz	N/A	N/A	N/A	not editable
118	Frequency 1 (Mass Calibration Verification)	hz	N/A	N/A	N/A	not editable
119	Audit K_0 Calibration Constant	N/A	N/A	N/A	N/A	not editable
120	Future Use	N/A	N/A	N/A	N/A	not editable
121	User-Defined Averaging Time	hour	2 - 23	8	8	S, X
122	Current Input Voltage	VAC	N/A	N/A	N/A	not editable
123	Current Ambient Temperature	°C	N/A	N/A	N/A	not editable
124	Current Ambient Pressure	atm	N/A	N/A	N/A	not editable

PROGRAM REGISTER CODES (125-153)						
Code	**Description**	**Units**	**Range**	**Default**	**Re-Init**	**Edit Modes**
125	Instrument Type	code*	0 - 2	N/A	N/A	not editable
126	Percent Difference of K0 Audit	%	-100 - 100	N/A	N/A	not editable
127	A/I Channel Currently Being Viewed	N/A	0 - 8	N/A	N/A	1, 2, 3, 4, S, X
128	Current A/I Type	code*	0 - 2	0	0	1, 2, 3, 4, S, X
129	Current A/I Constant A	N/A	N/A	0	0	1, 2, 3, 4, S
130	Current A/I Constant B	N/A	N/A	1	1	1, 2, 3, 4, S, X
131	Current A/I Constant C	N/A	N/A	1	1	1, 2, 3, 4, S, X
132	Current A/I % of Full Scale	%	0 - 100	N/A	N/A	not editable
133	Current A/I Average	N/A	N/A	N/A	N/A	not editable
134	Contact Closure 1 PRC	PRC	PRC Range	41	41	1, 2, 3, 4, S, X
135	Contact Closure 2 PRC	PRC	PRC Range	35	35	1, 2, 3, 4, S, X
136	Contact Closure 1 Operator	code*	0 - 7	7	7	1, 2, 3, 4, S, X
137	Contact Closure 2 Operator	code*	0 - 7	0	0	1, 2, 3, 4, S, X
138	Contact Closure 1 Value	N/A	N/A	7	7	1, 2, 3, 4, S, X
139	Contact Closure 2 Value	N/A	N/A	90	90	1, 2, 3, 4, S, X
140	Future use	N/A	N/A	N/A	N/A	not editable
141	Future use	N/A	N/A	N/A	N/A	not editable
142	Future use	N/A	N/A	N/A	N/A	not editable
143	Manometer, differential pressure between FTS and ambient	inches H_20	-100 - 100	N/A	N/A	1, 2, 3, 4, S, X
144	Manometer M, calibration constant M from FTS	N/A	-1 - 1	N/A	N/A	1, 2, 3, 4, S, X
145	Manometer B, calibration constant B from FTS	N/A	-1 - 1	N/A	N/A	1, 2, 3, 4, S, X
146	Frequency Wait	sec	0 - 300	90	90	S, X
147						
148						
149						
150						
151						
152						
153						
* Codes are decribed later in this Appendix.						

B.2. PRC Values Defined By Codes

Some of the Series 8500 FDMS Monitor's PRCs have values that are defined by codes. The codes are defined in this section.

PRC 014: Operating Mode

0	S	Setup
1	1	Operating Mode 1
2	2	Operating Mode 2
3	3	Operating Mode 3
4	4	Operating Mode 4
5	X	Stop All

PRC 041: Status Condition

0	OK	No Status Conditions
1	M	Frequency Signal Failure
2	T	Temperature(s) Outside of Bounds
4	F	Flow(s) Outside of Bounds
8	X	Exchange Filter
16	V	Voltage Low
32	C	Cooler Status
64	P	Valve Position
128	D	Drier Status
256	I	Inlet Humidity High

PRC 043: Current RS232 Mode

0	None
1	Print On Line
2	AK Protocol
3	German Protocol
4	Storage to Print
5	Fast Store Out

PRC 061: Protection Level

0	Unlock
1	Low
2	High

PRC 065: Maximum Analog Voltage

0	1 V
1	2 V
2	5 V
3	10 V

PRC 075: Analog Jumper Setting

0	2 - VDC
1	10 - VDC

PRC 094: Analog Calibration Mode

0	Off
1	On

PRC 136: Contact Closure Operator

0	<	Less Than
1	<=	Less Than or Equal
2	=	Equal
3	>=	Greater Than or Equal
4	>	Greater Than
5	<>	Not Equal
6	AND	And
7	NAND	Not And

PRC 137: Contact Closure Operator

0	<	Less Than
1	<=	Less Than or Equal
2	=	Equal
3	>=	Greater Than or Equal
4	>	Greater Than
5	<>	Not Equal
6	AND	And
7	NAND	Not And

Appendix C: Two-Way Serial Communication

The Series 8500 FDMS Monitor supports two serial communication protocols: the AK Protocol and the German Ambient Network Protocol. These protocols permit a locally or remotely located computer to obtain information electronically from the unit. These protocols are described in this appendix.

C.1. AK Protocol

The AK Protocol allows users to query the present value of any system variable remotely, and allows the user to change those system variable values. The user also can download information from the internal data logger. The RPComm software program uses this protocol for two-way communication directly to a personal computer (PC) or through a modem. The following AK Protocol commands are presented in detail on the following pages:

AREG — Ask Register Command. The user can query the Series 8500 FDMS Monitor for the current value of any system variable (Appendix B).

EREG — Enter Register Command. The user can assign a new value to any system variable. Great care must be taken when using this command, as the value of variables should only be changed when the monitor is in the appropriate operating mode.

SFxx — Set Function xx Command. The user can send commands using the <RUN> key and the <DATA STOP> key to the instrument. Each command is designated by a two-digit code, xx.

ASTO — Ask Storage Command. The user can download a specified number of records from the internal data logger from the current position of the data storage pointer. The location of this storage pointer may be defined by the SSTO command. The values on each line of output are delimited by commas.

SSTO — Set Storage Command. The user can change the location of the data storage pointer in the internal data logger, and is used in conjunction with the ASTO command described above. The data storage pointer is always located immediately after the last record transmitted through the RS232 port via the AK Protocol. If the circular buffer overwrites this location or if the ASTO or SSTO commands have not been used, the data storage pointer is positioned at the oldest record in the internal data logger.

The following pages show how RS-Para 1 through RS-Para 4 are defined in the AK Protocol, and also detail the format of the transmission and response messages of the commands listed above.

AK Protocol

Ask Register Command (AREG)

COM 2-WAY SETTINGS

RS-Para 1	52	ASCII code for the 1-digit Station Number (for example "4": 052). The Station Number is always 1 digit in length.
RS-Para 2	75048	ASCII code representation of the 2-digit Channel Number (for example: "K0": 075, 048). The Channel Number is always 2 digits in length.
RS-Para 3	13010	Optional: Up to 3 ASCII codes can be added to response from the instrument. In this case, <CR> and <LF> (ASCII codes 013 and 010) are appended to the response. Enter 0 if nothing is to be appended.
RS-Para 4	0	Not used.

Transmission to Instrument			Response from Instrument			
Byte	**Example**	**Description**	**B**	**No Err**	**Error**	**Description**
1	<STX>	ASCII code 002.	1	<STX>	<STX>	ASCII code 002.
2	4	1-digit Station Number, RS-Para 1.	2	4	4	1-digit Station Number, RS-Para 1.
3	A	Ask Register command.	3	A	A	4-digit Ask Register command.
4	R		4	R	R	
5	E		5	E	E	
6	G		6	G	G	
7	<space>	Space.	7	<space>	<space>	Space.
8	K	2-digit Channel Number as defined by RS Para 2.	8	0	0	Number of current status conditions.
9	0		9	<space>	<space>	Space.
10	<space>	Space.	10	9	S	Program Register Code of the variable whose value is being requested. The PRC may be up to 3 digits long and is not right-filled in the response.
11	9	Program Register Code of the variable whose value is being requested. The PRC may be up to 3 digits long. Do not right-fill if the PRC is less than 3 characters long.	11		E	
12			12		<ETX>	
13			13	<space>	<CR>	Space.
14	<ETX>	ASCII code 003.	14	9	<LF>	Current value of the variable referenced by the Ask Register command. NOTE: This value can be of varying length.
15			15	7		
16			16	4		
17			17	.		
18			18	3		
19			19	8		

AK Protocol

Ask Register Command (AREG) (continued)

Transmission to Instrument			Response from Instrument			
Byte	**Example**	**Description**	**B**	**No Err**	**Error**	**Description**
20			20	<ETX>		ASCII code 003.
21			21	<CR>		Up to 3 digits appended to the end of the response transmission, according to the entry for RS-Para 3.
22			22	<LF>		
23			23			
24			24			
25			25			
26			26			
27			27			
28			28			
29			29			
30			30			
31			31			
32			32			
33			33			
34			34			
35			35			
36			36			
37			37			
38			38			
39			39			
40			40			
41			41			
42			42			
43			43			
44			44			
45			45			
46			46			

AK Protocol

Enter Register Command (EREG)

COM 2-WAY SETTINGS

RS-Para 1	52	ASCII code for the 1-digit Station Number (for example "4": 052). The Station Number is always 1 digit in length.
RS-Para 2	75048	ASCII code representation of the 2-digit Channel Number (for example: "K0": 075, 048). The Channel Number is always 2 digits in length.
RS-Para 3	13010	Optional: Up to 3 ASCII codes can be added to response from the instrument. In this case, <CR> and <LF> (ASCII codes 013 and 010) are appended to the response. Enter 0 if nothing is to be appended.
RS-Para 4	0	Not used.

Transmission to Instrument			Response from Instrument			
Byte	**Example**	**Description**	**B**	**No Err**	**Error**	**Description**
1	<STX>	ASCII code 002.	1	<STX>	<STX>	ASCII code 002.
2	4	1-digit Station Number, RS-Para 1.	2	4	4	1-digit Station Number, RS-Para 1.
3	E	Enter Register command.	3	E	E	4-digit Enter Register command.
4	R		4	R	R	
5	E		5	E	E	
6	G		6	G	G	
7	<space>	Space.	7	<space>	<space>	Space.
8	K	2-digit Channel Number, as defined by RS Para 2.	8	0	0	Number of current status conditions.
9	0		9	<space>	<space>	Space.
10	<space>	Space.	10	6	S	Program Register Code of the variable whose value was entered. The PRC may be 1 to 3 digits long and is not right-filled in the response.
11	6	Program Register Code of the variable whose value is being requested. The PRC may be up to 3 digits long. Do not right-fill if the PRC is less than 3 characters long.	11	3	E	
12	3		12		<ETX>	
13			13	<ETX>	<CR>	ASCII code 003.
14	<space>	Space.	14	<CR>	<LF>	Up to 3 digits appended to the end of the response transmission, according to the entry for RS-Para 3.
15	2	New value to be entered for variable referenced by Program Register Code in bytes 11 to 13 above. NOTE: The value entered may be of varying length, and is not restricted to 4 bytes.	15	<LF>		
16	3		16			
17	8		17			
18	0		18			
19	<ETX>	ASCII code 003.	19			

AK Protocol

Set Function Command (SFxx)

RS-Para 1	52	ASCII code for the 1-digit Station Number (for example "4": 052). The Station Number is always 1 digit in length.
RS-Para 2	75048	ASCII code representation of the 2-digit Channel Number (for example: "K0": 075, 048). The Channel Number is always 2 digits in length.
RS-Para 3	13010	Optional: Up to 3 ASCII codes can be added to response from the instrument. In this case, <CR> and <LF> (ASCII codes 013 and 010) are appended to the response. Enter 0 if nothing is to be appended.
RS-Para 4	0	Not used.

Transmission to Instrument

Byte	Example	Description
1	<STX>	ASCII code 002.
2	4	1-digit Station Number, RS-Para 1.
3	S	Set Function command, where xx represents a 2-digit code between 00 and 32. These codes are defined below.
4	F	
5	x	
6	x	
7	<space>	Space.
8	K	2-digit Channel Number, as defined by RS Para 2.
9	0	
10	<ETX>	ASCII code 003.

LISTING OF FUNCTION CODES (xx):

03 <Run>
06 <Data Stop>
09 <F1>
17 <F5>
25 <Stop All>
26 Set Time

Response from Instrument

B	No Err	Error	Description
1	<STX>	<STX>	ASCII code 002.
2	4	4	1-digit Station Number, RS-Para 1.
3	S	S	4-digit Set Function command, with the 2-digit xx code corresponding to the function that was set.
4	F	F	
5	x	x	
6	x	x	
7	<space>	<space>	Space.
8	0	0	Number of current status conditions.
9	<ETX>	<space>	Space.
10	<CR>	S	Upto 3 digits appended to the end of the response transmission, according to the entry for RS-Para 3.
11	<LF>	E	
12		<ETX>	
13		<CR>	
14		<LF>	
15			
16			
17			
18			
19			

To Set Time Remotely:

1) Ensure that the instrument is in the Stop Mode.
2) Transmit the proper values in PRCs 2 through 6.
3) Execute the SF26 command.

AK Protocol

Ask Storage Command (ASTO)

COM 2-WAY SETTINGS

RS-Para 1	52	ASCII code for the 1-digit Station Number (for example "4": 052). The Station Number is always 1 digit in length.
RS-Para 2	75048	ASCII code representation of the 2-digit Channel Number (for example: "K0": 075, 048). The Channel Number is always 2 digits in length.
RS-Para 3	13010	Optional: Up to 3 ASCII codes can be added to response from the instrument. In this case, <CR> and <LF> (ASCII codes 013 and 010) are appended to the response. Enter 0 if nothing is to be appended.
RS-Para 4	0	Not used.

Transmission to Instrument			Response from Instrument			
Byte	**Example**	**Description**	**B**	**No Err**	**Error**	**Description**
1	<STX>	ASCII code 002.	1	<STX>	<STX>	ASCII code 002.
2	4	1-digit Station Number, RS-Para 1.	2	4	4	1-digit Station Number, RS-Para 1.
3	A	Ask Storage command.	3	A	A	4-digit Ask Storage command.
4	S		4	S	S	
5	T		5	T	T	
6	O		6	O	O	
7	<space>	Space.	7	<space>	<space>	Space.
8	K	2-digit Channel Number, as defined by RS Para 2.	8	0	0	Number of current status conditions.
9	0		9	<space>	<space>	Space.
10	<space>	Space.	10	3	S	Records to be downloaded from storage. This can be smaller than requested number due to end of file. Storage Marker moved to after last record transmitted. Not right-filled.
11	5	The number of records to be downloaded from the instrument's storage. Downloading begins at the storage marker, which can be set using the SSTO command.	11	1	E	
12	0		12		<ETX>	
13			13	<ETX>	<CR>	ASCII code 003.
14	<ETX>	ASCII code 003.	14	<CR>	<LF>	Up to 3 digits appended to the end of the response transmission, according to the entry for RS-Para 3.
15			15	<LF>		
16			16			
17			17	The instrument then transmits the number of storage records shown in response bytes10 through 12 above. Each record is followed by <CR><LF>.		
18			18			
19			19			

AK Protocol

Set Storage Marker Command (SSTO)

COM 2-WAY SETTINGS

RS-Para 1	52	ASCII code for the 1-digit Station Number (for example "4": 052). The Station Number is always 1 digit in length.
RS-Para 2	75048	ASCII code representation of the 2-digit Channel Number (for example: "K0": 075, 048). The Channel Number is always 2 digits in length.
RS-Para 3	13010	Optional: Up to 3 ASCII codes can be added to response from the instrument. In this case, <CR> and <LF> (ASCII codes 013 and 010) are appended to the response. Enter 0 if nothing is to be appended.
RS-Para 4	0	Not used.

Transmission to Instrument			Response from Instrument			
Byte	**Example**	**Description**	**B**	**No Err**	**Error**	**Description**
1	<STX>	ASCII code 002.	1	<STX>	<STX>	ASCII code 002.
2	4	1-digit Station Number, RS-Para 1.	2	4	4	1-digit Station Number, RS-Para 1.
3	S	Set Storage Marker command.	3	S	S	4-digit Set Storage Marker command.
4	S		4	S	S	
5	T		5	T	T	
6	O		6	O	O	
7	<space>	Space.	7	<space>	<space>	Space.
8	K	2-digit Channel Number, as defined by RS Para 2.	8	0	0	Number of current status conditions.
9	0		9	<ETX>	<space>	ASCII code 003.
10	<space>	Space.	10	<CR>	S	Up to 3 digits appended to the end of the response transmission, according to the entry for RS-Para 3.
11	B	New location of the Storage Marker. B:move to beginning of storage buffer. E: move to end of storage buffer. Enter positive numbers, such as 250, to move forward by 250 records, and negative numbers, such as -1000, to move backwards by 1000 records. Do not right fill.	11	<LF>	E	
12			12		<ETX>	
13			13		<CR>	
14			14		<LF>	
15			15			
16	<ETX>	ASCII code 003.	16			
17			17			
18			18			
19			19			

AK Protocol

Response if Command Addressed to Instrument is Unrecognizable

COM 2-WAY SETTINGS		
RS-Para 1	52	ASCII code for the 1-digit Station Number (for example "4": 052). The Station Number is always 1 digit in length.
RS-Para 2	75048	ASCII code representation of the 2-digit Channel Number (for example: "K0": 075, 048). The Channel Number is always 2 digits in length.
RS-Para 3	13010	Optional: Up to 3 ASCII codes can be added to response from the instrument. In this case, <CR> and <LF> (ASCII codes 013 and 010) are appended to the response. Enter 0 if nothing is to be appended.
RS-Para 4	0	Not used.

Transmission to Instrument			Response from Instrument			
Byte	Example	Description	B	No Err	Error	Description
1			1		<STX>	ASCII code 002.
2			2		4	1-digit Station Number, RS-Para 1.
3			3		?	Question marks inserted in place of unrecognizable command.
4			4		?	
5			5		?	
6			6		?	
7			7		<space>	Space.
8			8		0	Number of current status conditions.
9			9		<space>	Space.
10			10		S	Syntax error.
11			11		E	
12			12		<ETX>	ASCII code 003.
13			13		<CR>	Up to 3 digits appended to the end of the response transmission, according to the entry for RS-Para 3.
14			14		<LF>	
15			15			
16			16			
17			17			
18			18			
19			19			

C.2. German Ambient Network Protocol

Thermo's implementation of the German Ambient Network Protocol allows users to request the value of 1, 2 or 3 predetermined system variables. Due to the definition of this protocol, it is not possible to remotely select a system variable (Appendix B) to be queried.

The following pages show how RS-Para 1 through RS-Para 4 are defined in the German Ambient Network Protocol, and describe the format of the transmission and response messages.

German Network Protocol

COM 2-WAY SETTINGS

RS-Para 1	56052053	ASCII codes for 3-digit Instrument Identifier (for example "845": 056, 052, 053). The Instrument Identifier must be 3 bytes in length.
RS-Para 2	48048049	ASCII codes for 3-digit Location ID (for example "001": 048, 048, 049). The Location ID must be 3 bytes in length.
RS-Para 3	8	PRC of the variable to be transmitted by the instrument. Up to 3 PRCs may be designated for transmission by the instrument (for example MC and TM: 008 and 009).
RS-Para 4	13010	Optional: Up to 3 ASCII codes can be added to response from the instrument. In this case <CR> and <LF> (ASCII codes 013 and 010) are appended to the response. Enter 0 if nothing is to be appended.

Transmission to Instrument

Byte	Example	Description
1	<STX>	ASCII code 002.
2	D	The DA command signifies a request for data from the instrument.
3	A	
4	8	3-digit Instrument Identifier, as defined by RS-Para 1. These three bytes are optional.
5	4	
6	5	
7	<ETX>	ASCII code 003.
8	<CRC>	High byte followed by low byte of CRC. The CRCs may be replaced by a single <CR> character.
9	<CRC>	

DEFINITION OF CRC BYTES

The CRC bytes above (bytes 8 and 9) are the hexadecimal representation of the "exclusive or" of bytes 1 through 7. The high byte of the CRC is transmitted as byte 8 and the low byte is sent as byte 9.

Response from Instrument

B	No Err	Error	Description
1	<STX>	<STX>	ASCII code 002.
2	M	M	Response identifier to the DA command.
3	D	D	
4	0	0	Number of variables transmitted by the instrument, as specified by RS-Para 3. May be 01, 02 or 03.
5	1	1	
6	<space>	<space>	Space.
7	8	8	3-digit Instrument Identifier, as defined by RS-Para 1.
8	4	4	
9	5	5	
10	<space>	<space>	Space.
11	+ or -	+	Value of variable being transmitted, in the format +NNNN+EE. For example, a value of 63.7 is represented as +0637-01. If a syntax error exists or the value of the variable is 0, the instrument returns +0000+00.
12	n	0	
13	n	0	
14	n	0	
15	n	0	
16	+ or -	+	
17	e	0	
18	e	0	
19	<space>	<space>	Space.

German Network Protocol (continued)

Transmission to Instrument

Byte	Example	Description

CURRENT OPERATING MODE (Bytes 20, 21)

The two-digit hexadecimal representation of the current operating mode is determined as follows:

Mode 1	2
Mode 2	4
Mode 3	8
Mode 4	10 (decimal 16)
Mode S	0
Mode X	20 (decimal 32)

CURRENT STATUS CONDITION (Bytes 23, 24)

The 2-digit hexadecimal representation of the current status condition is computed by summing the numeric values for all current status conditions. Bytes 23 and 24 are both equal to 0 if if no current status condition exists.

0	OK	No current status conditions.
1	M	Mass Transducer.
2	T	Temperatures.
4	F	Flow Rates.
8	X	Exchange Filter.
16	V	Voltage Low.
32	C	Cooler status.
64	P	Valve position.
128	D	Drier status.

DEFINITION OF CRC BYTES

The CRC information in bytes 38 and 39 is the hexadecimal representation of the "exclusive or" of all response bytes. The high byte of the CRC is transmitted as byte 38 and the low byte is sent as byte 39.

Response from Instrument

B	No Err	Error	Description
20	1	1	2-digit hexadecimal representation of current instrument operating mode (see description at left).
21	0	0	
22	<space>	<space>	Space.
23	0	0	2-digit hexadecimal representation of current instrument status condition (see description at left).
24	0	0	
25	<space>	<space>	Space.
26	0	0	3-digit Location ID, as defined by RS-Para 2.
27	0	0	
28	1	1	
29	<space>	<space>	Space.
30	0	9	3-digit PRC of the variable being transmitted, zero-filled from the left. These bytes are not defined in the German Protocol, but are included for informational purposes.
31	0	9	
32	8	9	
33	<space>	<space>	These bytes are not defined in the German Protocol, and are reserved for future definition.
34	<space>	<space>	
35	<space>	<space>	
36	<space>	<space>	Space.
37	<ETX>	<ETX>	ASCII code 003.
38	<CRC>	<CRC>	High byte and low byte of CRC. The CRCs are replaced by a single <CR> if transmit byte 8 was <CR>.
39	<CRC>	<CRC>	
40	<CR>	<CR>	Up to 3 digits appended to the end of the response transmission, according to the entry for RS-Para 4.
41	<LF>	<LF>	
42			

NOTE ABOUT MULTIPLE PRC CODES

If more than one Program Register Code is specified in RS-Para 3, byte 5 of the response transmission is either 2 or 3, and bytes 7 to 36 are repeated for each Program Register Code.

Appendix D: Installing New Software

The TEOM 8500 FDMS Monitor's instrument software is stored in battery-backed random access memory. New revisions of the system software can be loaded directly into the instrument with a PC. This appendix explains how to convert your TEOM 1400a control unit into a TEOM 8500 FDMS Monitor by uploading the system software that came with your TEOM 8500 FDMS Module (Section D.1). This appendix also explains how to install new system software into the TEOM 8500 FDMS Monitor (Section D.2), and how to obtain and load RPComm onto your PC (Section D.3).

System requirements for running RPComm software are:

- Pentium processor
- 64 megabytes (MB) of random access memory (RAM)
- 40 MB of hard drive space.

IMPORTANT: If you have purchased the TEOM 8500 FDMS Module as an add-on kit to an already existing TEOM TEOM 1400a system, you must first load the new system software that came with the 8500 module into your TEOM 1400a control unit (Section D.1). This will convert your TEOM 1400a system into an TEOM 8500 FDMS Monitor.

NOTE: Be sure to check Thermo Scientific's website before uploading new software to ensure that you have the latest software version for either the unit's operating software or RPComm. Users must log in and obtain a password to download new software. Go to:

http://www.tagteam.com/TagTeam/Client/login.asp?

NOTE: The RPComm software for the TEOM 8500 FDMS Monitor is a Microsoft Windows-based program. Users should have a general understanding of their personal computer (PC) and of the Windows operating system, including entering and editing text, and opening, closing and saving files.

D.1. Converting the 1400a to an 8500

To convert your TEOM 1400a Ambient Particulate Monitor into a TEOM 8500 FDMS Monitor, you must install the system software that came with the FDMS Module. First, remove the existing software program from your TEOM 1400a control unit (Section D.1.1). Then connect the TEOM 1400a control unit to a PC (Section D.1.2). After establishing a connection between your control unit and PC, load the 8500 software into the control unit (Section D.1.3).

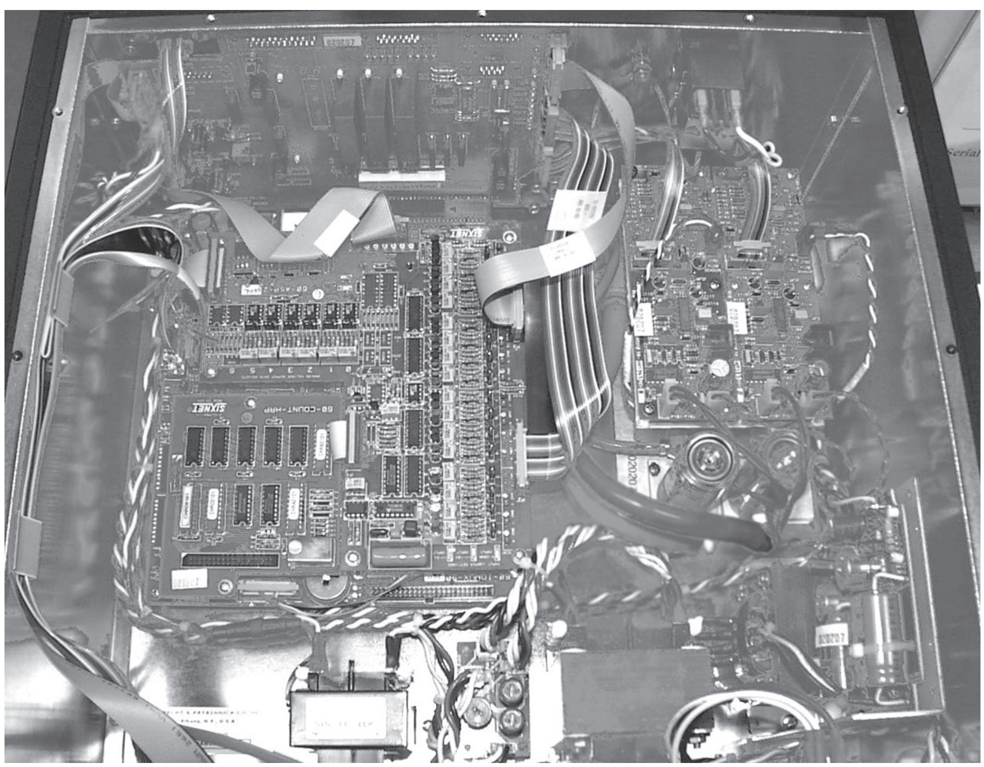
D.1.1. Removing the Existing Software Program

Follow these steps to remove the existing software program from the control unit:

✘ Always wear appropriate anti-static devices when working with the system electronics.

1) **Turn off the control unit.**
2) **Attach a ground strap around your wrist. Attach the other end of the strap to a ground source such as the control unit's enclosure.**
3) **Remove the top cover of the control unit by unscrewing the screws holding the top cover plate in place (Figure D-1).**

Figure D-1. Control unit with cover removed.



4) Locate the IOMUX board (Figure D-2) on the center, left-hand side of the control unit.

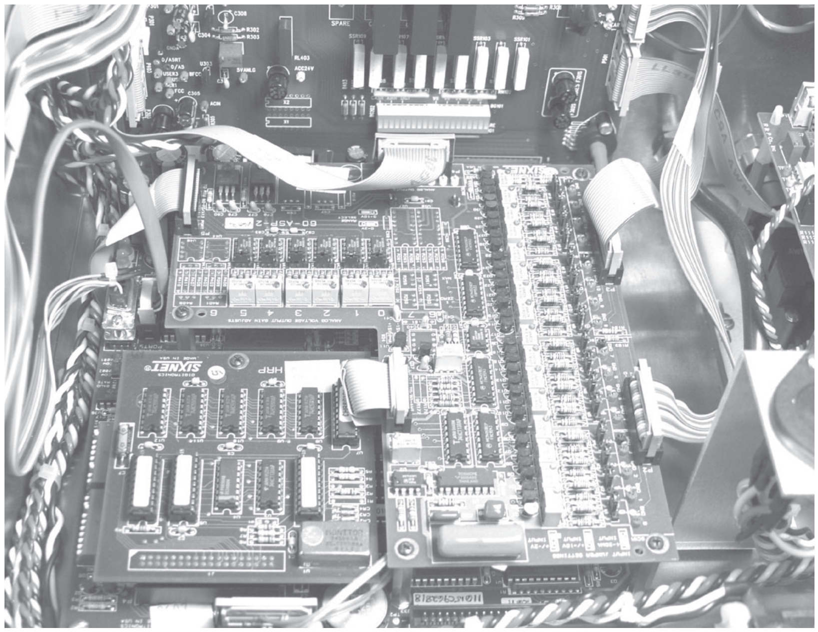


Figure D-2. Electronics boards located on the center left-hand side of the control unit.

5) Locate the two banks of DIP switches on the bottom, left-hand corner of the IOMUX board (Figure D-3).

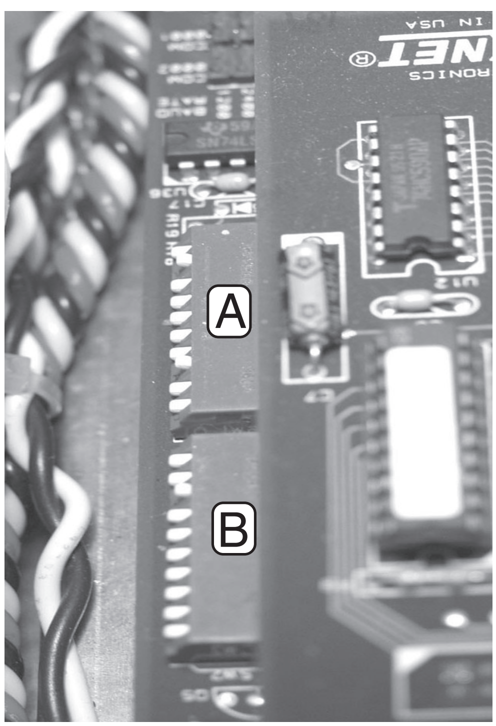


Figure D-3. Two banks of DIP switches on the IOMUX board with SW1 bank (A) and SW2 bank (B) highlighted.

6) **Locate the SW1 bank of DIP switches (Figure D-3).**

7) **Record the position of the switches on the SW1 bank (Figure D-4).**

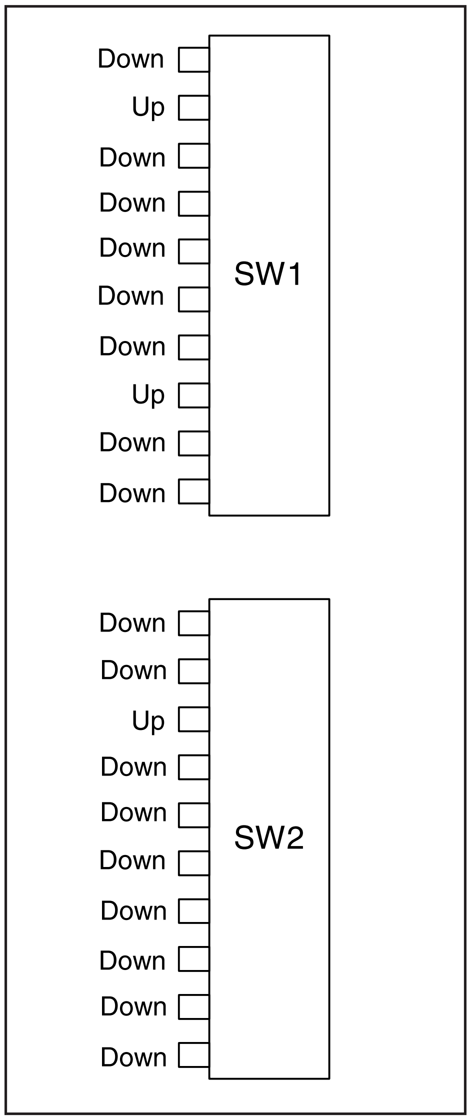


Figure D-4. Original positions of the DIP switches on the SW1 and SW2 banks.

8) **Change the positions of all of the switches on SW1 to their open (upward) position.**

9) **Turn on the control unit.**

10) **Check the small red status light (Figure D-5) located above the DIP switches. The light should be flashing rapidly.**

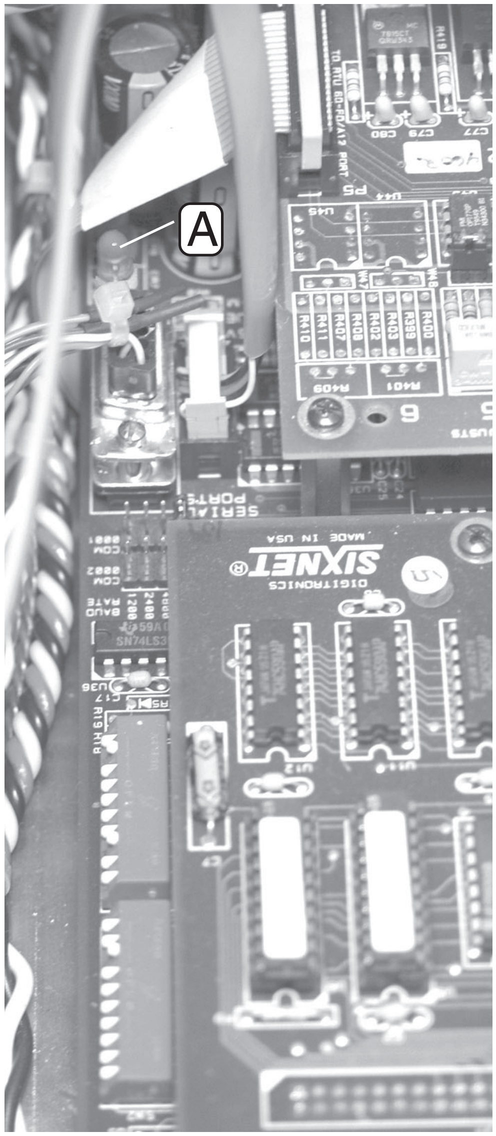


Figure D-5. IOMUX board with red status light (A) highlighted.

11) Turn off the control unit.

12) Reset the switches on the SW1 bank to their original positions, that you recorded in step 6.

13) Turn on the control unit.

14) Check the small red status light (Figure D-5) located above the DIP switches. The light should flash, briefly remain off, and then flash again repeatedly.

15) Replace the cover on the control unit. Go to Section D.1.2.

D.1.2. Connecting the Control Unit to a Personal Computer

Follow these steps to connect the personal computer to the monitor:

1) **Connect one end of the 9-to-9 pin computer cable to one of the RS232 ports on the control unit.**
2) **Ensure that nothing is connected to the other RS232 port of the control unit.**
3) **If your PC is equipped with a 9-pin RS232 connector, go to step 4. If your personal computer is equipped with a 25-pin connector, go to step 5.**
4) **Plug the other end of the 9-to-9 pin computer cable into the 9-pin RS232 port of your PC. Go to Section D.1.3.**
5) **Locate the 9-to-25 pin computer cable adapter.**
6) **Plug the 9-to-25 pin computer cable adapter into the 25-pin port on your PC.**
7) **Plug the other end of the 9-to-9 pin computer cable into the 9-to-25 pin computer cable adapter. Go to Section D.1.3.**

   NOTE: Do not use the 9-to-25 pin modem cable to connect the control unit with the PC. The 9-to-25 pin modem cable is configured for use only with a modem.

D.1.3. Loading the 8500 System Software Into the Control Unit

IMPORTANT: If you have purchased the TEOM 8500 FDMS Module as an add-on kit to an already existing TEOM 1400a system, you must first load the new system software that came with the 8500 module into your TEOM 1400a control unit. This will convert your TEOM 1400a system into a TEOM 8500 FDMS Monitor.

Follow these steps to install the 8500 software into the control unit:

1) **Remove the existing software program from the control unit (Section D.1.1).**
2) **Connect your PC to the control unit (Section D.1.2).**
3) **Restart your PC and ensure that it is in MS-DOS mode.**
4) **Type the following command after the MS-DOS command prompt:**

   LOADALL [p] [bbbbb]

   where:

   [p] An optional parameter specifying the serial port (COM1 or COM2) used on the personal computer (PC) connected to the control unit. This parameter does not need to be entered if COM1 is being used on the personal computer. If you are using COM2, enter a “2” for this parameter.

   [bbbbb] An optional parameter for the baud rate at which the RS232 port of the control unit is configured. Examples of baud rates that can be entered are 1200, 2400, 4800, 9600, or 19200. The default value is 9600 bps.

   NOTE: If an MS-DOS “environment error” occurs while following one of the above commands, add the following statement to the CONFIG.SYS file of your computer:

   SHELL = C:\DOS\COMMAND.COM /P /E:768

5) **Press Enter.**
6) **When the “STATUS” light begins to blink, press any key.**
7) **The Title screen and then the Main screen (Figure D-6) will display on the control unit’s four-line display. Press <DATA STOP> to enter the Setup Mode.**
8) **Press and hold the <SHIFT> key.**

Figure D-6. Main screen.

```
OK    4+  21%  NU     09:39
Mass Conc              11.5
01-Hr MC               12.5
08-Hr MC                8.3
```

9) While pressing <SHIFT>, press <STOP ALL> to cause the unit to perform a full software reset.

10) The Title screen and then the Main screen will display again on the control unit's four-line display.

11) In the Main screen, press <STEP SCREEN> to display the Menu screen (Figure D-7).

12) In the Menu screen, select "Set Hardware" and press <ENTER> to display the Set Hardware screen (Figure D-8).

Figure D-7. Menu screen.

```
  LISTING OF SCREENS
> Set Temps/Flows
  Set Hardware
  View Analog Inputs
```

13) Press <EDIT> and enter all necessary operating parameters into the Set Hardware screen (Section 6).

14) Press <ENTER> to save the changes.

Figure D-8. Set Hardware screen.

```
       SET HARDWARE
Cal Const>          9605
Ser Num            22822
Wait Time           1800
```

15) When in the Set Hardware screen, press the <STEP SCREEN> key. This will display the Set Temps/Flows screen (Figure D-9).

16) Press the <EDIT> key and enter the appropriate temperature and pressure values for your sampling setup (Section 6) into the Set Temps/Flows screen (Section 6).

Figure D-9. Set Temps/ Flows screen.

```
      SET TEMPS/FLOWS
T-Case>    30.00    30.00
T-Air      30.00    30.00
T-Cap      30.00    29.98
```

17) Press the <ENTER> key to save your changes.

18) Press the <MAIN/STATUS> key to display the Main screen.

19) Verify and change (if necessary) any other optional system parameters for your sampling setup, such as the time (Section 6), analog output settings (Section 9), contact closure settings (Section 9), analog input conversions (Section 9) and RS232 settings (Section 9).

20) Press the <F1> or <RUN> key to enter Operating Mode 1 and begin data collection.

D.2. Installing New System Software

To install new 8500 system software into the TEOM 8500 FDMS Monitor, you must first connect the monitor to a personal computer (PC) (Section D.2.1). After you have established a connection between your monitor and your PC, you can then load the new software into the monitor (Section D.2.2).

However, if you have purchased the TEOM 8500 FDMS Monitor as an add-on kit to an already existing TEOM 1400a system, you must first convert the TEOM 1400a system to a TEOM 8500 FDMS system by loading the new system software that came with the 8500 module into your TEOM 1400a control unit (Section D.1). After you have converted the TEOM 1400a system into a TEOM 8500 FDMS system, you may then follow the instructions in Sections D.2.1 and D.2.2 to upload a newer version of 8500 system software into the control unit.

D.2.1. Connecting the Monitor to a Personal Computer

Your personal computer must be connected to the monitor's control unit.

Follow these steps to connect the personal computer to the monitor:

1) **Connect one end of the 9-to-9 pin computer cable to one of the RS232 ports on the control unit.**
2) **Ensure that nothing is connected to the other RS232 port of the control unit.**
3) **If your personal computer (PC) is equipped with a 9-pin RS232 connector, go to step 4. If your personal computer is equipped with a 25-pin connector, go to step 5.**
4) **Plug the other end of the 9-to-9 pin computer cable into the 9-pin RS232 port of your PC. Go to step 8.**
5) **Locate the 9-to-25 pin computer cable adapter.**
6) **Plug the 9-to-25 pin computer cable adapter into the 25-pin port on your PC.**
7) **Plug the other end of the 9-to-9 pin computer cable into the 9-to-25 pin computer cable adapter. Go to step 8.**

   NOTE: Do not use the 9-to-25 pin modem cable to connect the control unit with the PC. The 9-to-25 pin modem cable is configured for use only with a modem.
8) **Ensure that the Main screen (Figure D-6) is displayed on the control unit's four-line display.**

9) Press <F2> on the control unit's keypad until an "N" (None Mode) displays in the RS232 Mode field of the Main screen's status line (Figure D-10). The instrument must remain in the None Mode while executing the computer routines described in this section.

Figure D-10. Main screen with the RS232 Mode field highlighted.

RS232 Mode field

```
OK     4+  21%  NU      09:39
Mass Conc               11.5
01-Hr MC                12.5
08-Hr MC                 8.3
```

D.2.2. Loading New System Software Into the Monitor

IMPORTANT: If you have purchased the TEOM 8500 FDMS Module as an add-on kit to an already existing TEOM 1400a system, you must load the new system software that came with the 8500 module into your TEOM 1400a control unit. This will convert your TEOM 1400a system into a TEOM 8500 FDMS Monitor.

Follow these steps to install a newer version of 8500 system software into the monitor:

1) **When in the Main screen (Figure D-6) of the control unit, press <STEP SCREEN> to display the Menu screen (Figure D-7).**
2) **When in the Menu screen, press the up and down arrow keys to select "Set Hardware." Press <ENTER> to display the Set Hardware screen (Figure D-8).**
3) **Record all operating parameters in the Set Hardware screen.**
4) **When in the Set Hardware screen, press <STEP SCREEN>. This will display the Set Temps/Flows screen (Figure D-9).**
5) **Record all temperature and pressure values for your sampling setup in the Set Temps/Flows screen.**
6) **Connect your PC to the control unit (Section D.1.1).**
7) **Restart your PC and ensure that it is in MS-DOS mode.**
8) **Type the following command after the MS-DOS command prompt:**

   LOADALL [p] [bbbbb]

   where:

   [p] An optional parameter specifying the serial port (COM1 or COM2) used on the personal computer (PC) connected to the control unit. This parameter does not need to be entered if COM1 is being used on the personal computer. If you are using COM2, enter a "2" for this parameter.

   [bbbbb] An optional parameter for the baud rate at which the RS232 port of the control unit is configured. Examples of baud rates that can be entered are 1200, 2400, 4800, 9600, or 19200. The default value is 9600 bps.

   NOTE: If an MS-DOS "environment error" occurs while following one of the above commands, add the following statement to the CONFIG.SYS file of your computer:

   SHELL = C:\DOS\COMMAND.COM /P /E:768

9) Press Enter.

10) The “STATUS” light will begin to blink. Press any key.

11) The Title screen and then the Main screen will display on the control unit’s four-line display. Press <DATA STOP> on the monitor’s keypad to enter the Setup Mode.

12) Press <SHIFT> and continue to hold it down.

13) While you are pressing the <SHIFT> key, press <STOP ALL>. This will cause the unit to perform a full software reset.

14) The Title screen and then the Main screen will display again on the control unit’s four-line display.

15) When in the Main screen, press <STEP SCREEN> to display the Menu screen.

16) When in the Menu screen, press the up and down arrow keys to select “Set Hardware.” Press <ENTER> to display the Set Hardware screen.

17) Press <EDIT> and enter all operating parameters into the Set Hardware screen that you recorded in step 3.

18) Press <ENTER> to save your changes.

19) When in the Set Hardware screen, press <STEP SCREEN>. This will display the Set Temps/Flows screen.

20) Press <EDIT> and enter the appropriate temperature and pressure values for your sampling setup (Section 6) into the Set Temps/Flows screen that you recorded in step 5.

21) Press <ENTER> to save your changes.

22) Press <MAIN/STATUS> to display the Main screen.

23) Verify and change (if necessary) any other optional system parameters for your sampling setup, such as the time (Section 6), analog output settings (Section 9), contact closure settings (Section 9), analog input conversions (Section 9) and RS232 settings (Section 9).

24) Press <F1> or <RUN> to enter Operating Mode 1 and begin data collection.

D.3. Installing RPComm

D.3.1. Uninstalling Previous Versions of RPComm Software

If a previous version of RPComm has been loaded onto your personal computer (PC), you must remove it before uploading a new or updated version of software. Use the Add/Remove Control Panel function on your PC to remove the old program.

D.3.2. Obtaining RPComm Installation Files

The RPComm installation files can be downloaded from Thermo Scientific's Web site. Users must log in and obtain a password to download new software. Go to:

http://www.tagteam.com/TagTeam/Client/login.asp?

D.3.3. Installing RPComm Onto a Personal Computer (PC)

Follow these steps to install RPComm onto a PC:

1) **Exit all Windows programs that you currently have running on your PC.**
2) **The software program "rpcomm.exe," as downloaded from the company website, is a self-executable file and will install itself onto the computer when executed. Double-click on the file name to start the installation process.**
3) **Follow the instructions in the RPComm InstallShield Wizard screen to complete the installaton.**

   NOTE: If your PC displays an "Overwrite Protection" screen that asks you to choose whether you would like overwrite any installation files that may already be on your computer, select the "Yes" button.
4) **The RPComm InstallShield Wizard screen with an "InstallShield Wizard Completed" message will display. You do not need to restart your computer to use RPComm. It is now available in your PC's "Program" menu.**

   NOTE: The RPComm program is equipped with an "Auto Start" ("Autorun") function. This means that every time that you turn on your PC, the RPComm software application will automatically begin running. If you close the RPComm software application to use other software, you may start it manually from the "Start" menu.

D.3.4. Updating the List of Program Register Codes in RPComm

NOTE: Refer to Section 10 for further information on using the RPComm software program.

All 8500 monitors have a list of system variables that is specific to that type of unit. A system variable is any value that is entered into, calculated by, or measured by the instrument. This list of system variables is called the "program register code" ("PRC") list.

When the monitor's software is modified, the PRC list often is affected; usually, new PRCs must be added for software enhancement. If there are new PRCs, then the PRC list must be updated within the RPComm software program. This can be accomplished by:

1) The entire RPComm program can be downloaded from the Thermo Scientific website and installed on the computer, as described in Section D.3. However, this is necessary only if the revision number of the RPComm software program has changed. Changes to the unit's operating software do not always require that you download the new RPComm program.

2) A new PRC list can be downloaded from Thermo's website and installed on your computer. This will update the PRC list within RPComm without requiring the user to reinstall the entire program.

Follow these steps to update the PRC list within RPComm:

1) Go to the RPComm directory on your computer's hard drive and look at the files. The PRC lists are located in this directory. Determine which PRC list revision you have in your RPComm directory. The file name for the PRC lists have the following format:

Rp{instrument}n.nnn

where: {instrument} = instrument model (2000FRM, 2025, 1400 or 5400)

n.nnn = PRC list revision

2) Go to the Software to Download area of the Thermo website as described in Section D.3.2. If there is a new PRC list available for the TEOM 8500 FDMS Monitor, it will be listed on this web page.

3) **There may be multiple PRC lists on this page, one for each instrument that RPComm supports. Determine if there is an updated PRC list for the TEOM 8500 FDMS Monitor. Select the appropriate PRC list and save it to a file.**

   NOTE: Be sure to remember what folder the PRC list file is saved in.

4) **Disconnect from the World Wide Web.**

5) **If RPComm is running, exit the program.**

6) **Copy the downloaded PRC list to the RPComm directory on your computer's hard drive. The next time you execute RPComm, the program will automatically use the new PRC list in its operations.**

Appendix E: Consumables and Parts

This appendix lists the consumables and parts available for the Series 8500 FDMS Monitor.

E.1. Consumables

The operation of the Series 8500 FDMS Monitor requires the following consumable items. Replacement intervals will vary depending upon sampling location and particle loading.

Average annual consumables pack	59-008158
(new style flow controller)	
includes:	
TX40 filters (box of 20)	57-007225-0020
4 large bypass in-line filters	57-002758
Average annual consumables pack	59-003578
(original design flow controller)	
includes:	
TX40 filters (box of 20)	57-007225-0020
4 large bypass in-line filters	57-002758
2 flow controller filters	30-003097
4 flow controller orifices	32-003339
TX40 filters (box of 10)	57-007225-0010
TX40 filters (box of 20)	57-007225-0020
Large bypass in-line filter (all models)	57-002758
Flow controller filter	30-003097
Flow controller orifice	32-003339
Mass calibration verification kit (all models)	59-008298
Refill for mass calibration verification kit (all models)	59-008299
5-filter mass calibration verification kit	59-008298-0005
Refill for 5-filter mass calibration verification kit	59-008299-0005
Bypass line water trap filter	32-005933

E.2. Parts

Thermo offers certain electrical components at reduced prices when a customer returns a defective part. These items are indicated by the word "exchange" (i.e., 55-003326-EXCH) next to the part description on the price list. Replacement parts supplied can be either new or reconditioned. Exchange prices must be authorized by the R&P service department before a purchase order will be accepted. Components must be judged by the service department to be repairable in order for an exchange to be authorized. The defective item must then be returned to Thermo within one month of shipment of the replacement part, or the customer will be invoiced for the full list price of the unreturned component.

The following is a list of major parts in the Series 8500 FDMS Monitor, along with their Thermo part numbers:

Flow Controllers and Flow Accessories	
Flow splitter	57-001667
Nylon tubing, 3/8" OD	24-000483
Dual flow controller (original design flow controller)	55-003326
Dual flow controller (original design flow controller) (exchange)	55-003326-EXCH
Single flow controller (original design flow controller)	55-003603
Single flow controller (original design flow controller) (exchange)	55-003603-EXCH
Original design flow controller maintenance package	55-003603
Flow sensor, 20 l/min	10-002415
Flow sensor, 5 l/min	10-003312
New style flow controller,	55-007675
New style flow controller (exchange)	55-007675-EXCH
1400AB flow controller upgrade package	55-007758
Miscellaneous Components	
15 VDC power supply	10-000233
Frequency counter P.C.B.	10-000394
Frequency counter P.C.B. (exchange)	10-000394-EXCH
Replacement shoes (3) for tripod	10-000447
Filter exchange tool	55-002013-0001
Display/keypad with English overlay	10-001589-0USA
Display/keypad with Spanish overlay	10-001589-0SPN
Display/keypad with German overlay	10-001589-0GER
Key for instrument enclosure	20-005922

Series 1400a Control Unit and Sensor Unit — Specific Components	
Main computer P.C.B.	10-001594-0006
Main computer P.C.B. (exchange)	10-001594-0006-EXCH
Analog I/O P.C.B.	10-001595-0016
Analog I/O P.C.B. (exchange)	10-001595-0016-EXCH
LED status light	05-001794
Probe air thermistor	56-002744
Amplifier P.C.B.	50-002820
Amplifier P.C.B. (exchange)	50-002820-EXCH
Mass transducer assembly (exchange)	54-003582-EXCH
Interface P.C.B.	50-003232
Interface P.C.B. (exchange)	50-003232-EXCH
Temperature sensor cable, 10 m	51-003355
Transformer, ±15 V	03-003407
Transformer, ±12 V	03-003408
FDMS—Specific Components	
Switch valve assembly	56-009420
Switch valve assembly (exchange)	56-009420-EXCH
Nafion dryer assembly with sensors	56-009477
Nafion dryer assembly with sensors (exchange)	56-009477-EXCH
Chiller/conditioner assembly	56-009445
Chiller/conditioner assembly (exchange)	56-009445-EXCH
Connecting Cables	
Electric & air cable, 2 m, 1 air flow line	51-003613-0002
Electric & air cable, 10 m, 1 air flow line	51-003613-0010
Electric & air cable, 20 m, 1 air flow line	51-003613-0020
Electric & air cable, 2 m, 2 air flow line	51-003336-0002
Electric & air cable, 10 m, 2 air flow lines	51-003336-0010
Electric & air cable, 20 m, 2 air flow lines	51-003336-0020
Data Cables	
Cable, USB to serial	07-010239
Pumps	
Piston pump, 120 V, 60 Hz, 1/4 hp	10-001403
Piston pump, 240 V, 50 Hz, 1/4 hp	10-001404
Piston pump rebuild kit	59-008630

Push-to-Connect Fittings and Collets	
Straight 1/4" fitting	32-001017
Straight 3/8" fitting	32-001531
Straight 1/2" fitting	36-001039
Elbow 1/4" fitting	32-001023
Elbow 1/4" to 3/8" fitting	32-001041
3/8" tube x 1/4" FNPT straight	32-002756
Reducer, 3/8" tube to 1/4" tube	32-003271
1/4" collet	32-001852-0004
3/8" collet	32-001852-0006
1/2" collet	32-001852-0008
Batteries	
Battery/clock for U39 (revision B board)	06-001629
Battery for U33 (revision B board)	06-001628
Battery (round) (revision B board)	12-002049
Inlet Parts	
O-rings used in PM-10 inlet:	
O-ring, 1 1/4" ID, Viton	22-002853-3026
O-ring, 2 3/8" ID, BUNA	22-000485-1036
Jar for PM-10 inlet	55-010841
PM-10 screw, #6-32 x 1/4"	21-003721-0004
PM-10 standoff	12-000620-0020
Fuses	
0.5 A @ 250 V (voltage set fuse)	04-003417
2 A @ 250 V (in-line fuse)	04-003419
5 A @ 250 V (F301 on inteface board)	04-003576
2 A @ 230 V (F302 on interface board)	04-004628
1 A @ 230 V (slow blow in Corcom)	04-003267
2 A @ 115 V (slow blow in Corcom)	04-003268
Power Cords	
Power cord (U.S.), 120 VAC	07-000593
Power cord (U.S.), 240 VAC	07-002675
Power cord (German), 240 VAC	07-002674
Manuals	
Series 8500 FDMS Operating Manual	42-010874
Series 1400a Service Manual (AB)	42-003348

Appendix F: Filter Log

This appendix contains a filter log to keep track of readings associated with each exposed filter. Thermo encourages users to make photocopies of the form or use a similar form.

FDMS Series 8500 Filter Log

Filter Number	Initial Conditioning	Initial Weighing	Filter Exposure	Post-Collection Conditioning	Post-Collection Weighing	DW W(F) - W(I)	Concentration DWx10^6/Volume
		Weights: W1: W2: W3: W(I):	**Exposure Time:**		**Weights:** W1: W2: W3: W(F):		
	Conditions: RH: Temp: Date: Time:	**Conditions:** RH: Temp: Date: Time:	**Exposure Stats:** Val Time; Tot Time: Volume:	**Conditions:** RH: Temp: Date: Time:	**Conditions:** RH: Temp: Date: Time:		
		Weights: W1: W2: W3: W(I):	**Exposure Time:**		**Weights:** W1: W2: W3: W(F):		
	Conditions: RH: Temp: Date: Time:	**Conditions:** RH: Temp: Date: Time:	**Exposure Stats:** Val Time; Tot Time: Volume:	**Conditions:** RH: Temp: Date: Time:	**Conditions:** RH: Temp: Date: Time:		
		Weights: W1: W2: W3: W(I):	**Exposure Time:**		**Weights:** W1: W2: W3: W(F):		
	Conditions: RH: Temp: Date: Time:	**Conditions:** RH: Temp: Date: Time:	**Exposure Stats:** Val Time; Tot Time: Volume:	**Conditions:** RH: Temp: Date: Time:	**Conditions:** RH: Temp: Date: Time:		
		Weights: W1: W2: W3: W(I):	**Exposure Time:**		**Weights:** W1: W2: W3: W(F):		
	Conditions: RH: Temp: Date: Time:	**Conditions:** RH: Temp: Date: Time:	**Exposure Stats:** Val Time; Tot Time: Volume:	**Conditions:** RH: Temp: Date: Time:	**Conditions:** RH: Temp: Date: Time:		

Appendix G: Inlet Maintenance

This appendix contains maintenance procedures for the PM-10 inlet, modified PM-10 inlet, sharp cut cyclone (SCC) PM-1 and PM-2.5 inlets.

G.1. Cleaning the PM-10 and Modified PM-10 Inlets

Supplies and tools recommended for maintenance:

Ammonia-based, general-purpose cleaner
Cotton swabs
Small soft-bristle brush
Paper towels
Distilled water
Silicone-based stopcock grease
Small screwdriver
Small crescent wrench
Pocket knife

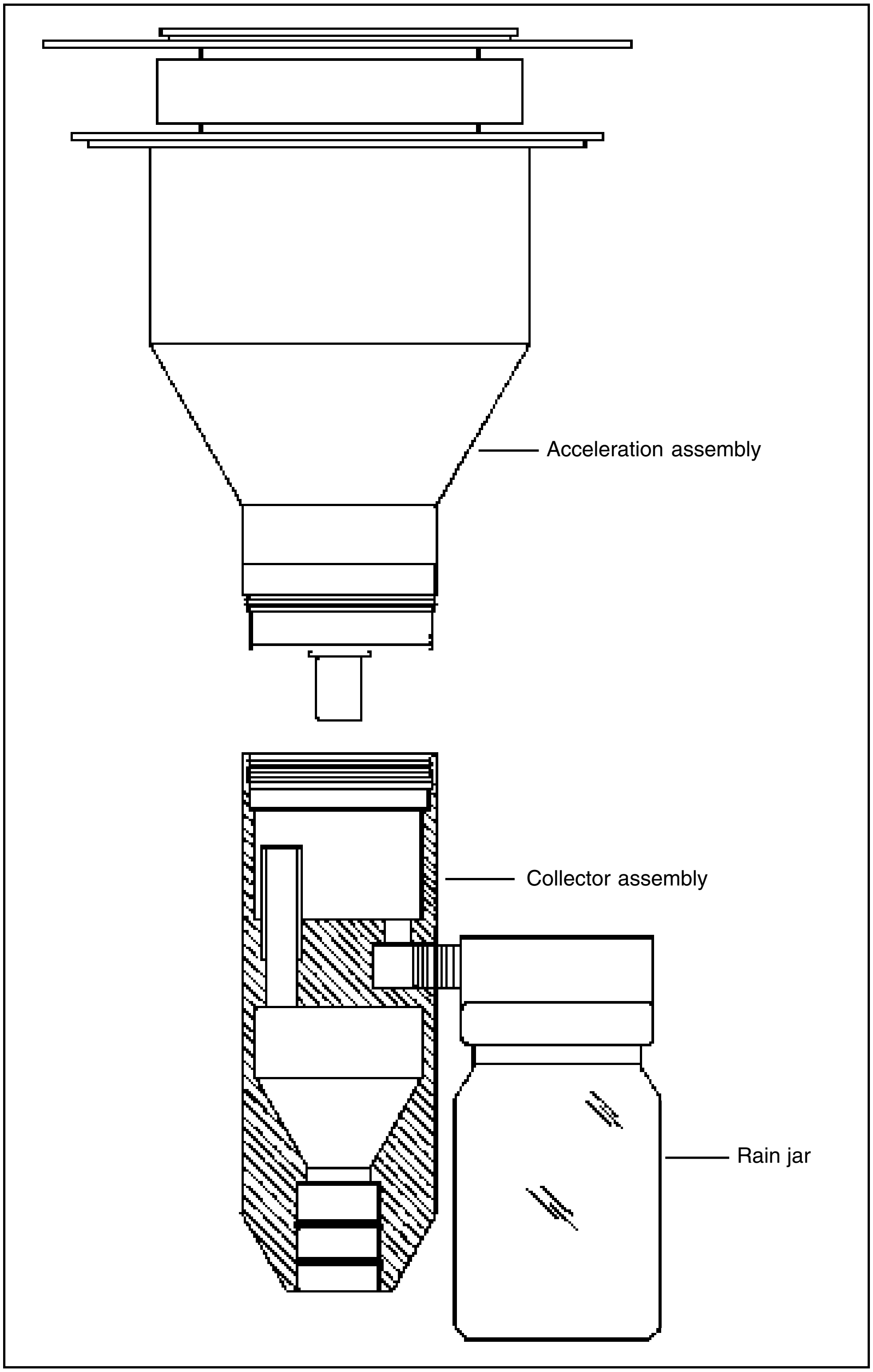
Thermo recommends cleaning and maintaining the PM-10 inlet every 1 to 3 months of continuous operation. This includes removing the inlet from the unit, cleaning it and checking its O-ring for signs of damage or wear. Because the PM-10 inlet is similar in construction to the modified PM-10 inlet, the maintenance procedures are the same for both inlets.

G.1.1. Removing the Inlet

Follow these steps to remove and disassemble the inlets:

1) **To remove the inlet, lift the entire inlet assembly upward off the flow splitter.**
2) **Remove the rain jar and set it aside.**
3) **Disassemble the upper and lower inlet halves by unscrewing, counterclockwise, the top acceleration assembly from the lower collector assembly (Figure G-1).**

Figure G-1. Schematic drawing of the PM-10 inlet with the top acceleration assembly disassembled from the lower collector assembly.

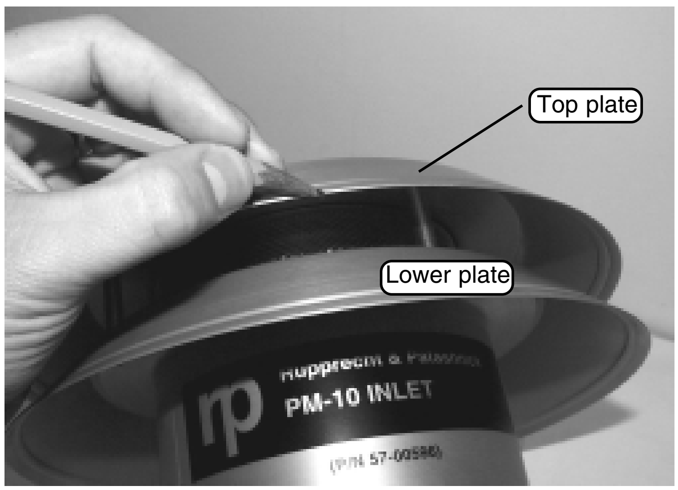


G.1.2. Cleaning the Top Acceleration Assembly

Follow these steps to clean and maintain the top acceleration assembly:

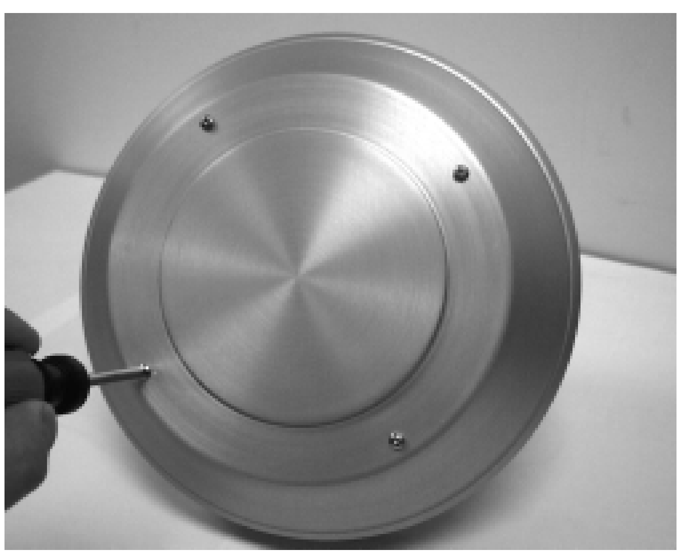
1) Mark the top plate deflector cone and lower plate with a pencil to facilitate proper orientation when reassembling the assembly after cleaning and maintenance (Figure G-2).

Figure G-2. Marking the top plate deflector and lower plate.



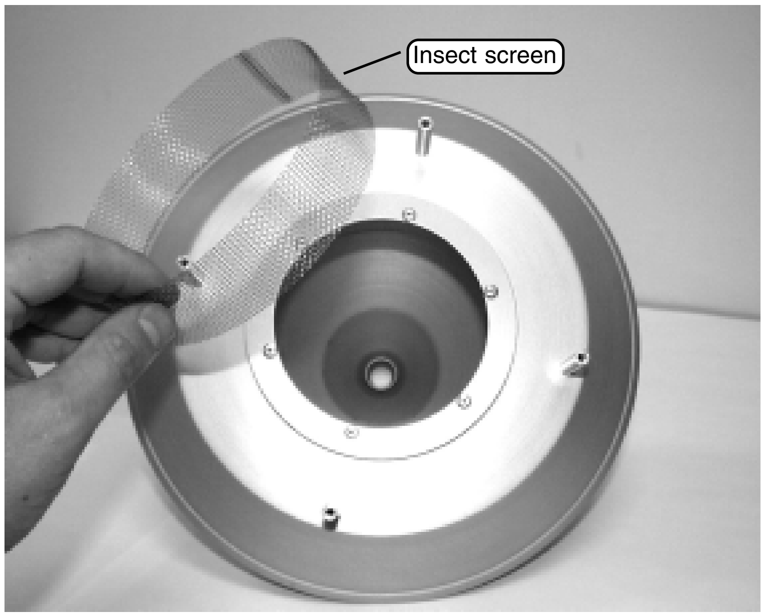
2) Using a Phillips screwdriver, remove the four pan head screws from the top of the top plate (Figure G-3). Lift the top plate off the four threaded, spacer standoffs and set aside.

Figure G-3. Removing the four pan head screws.



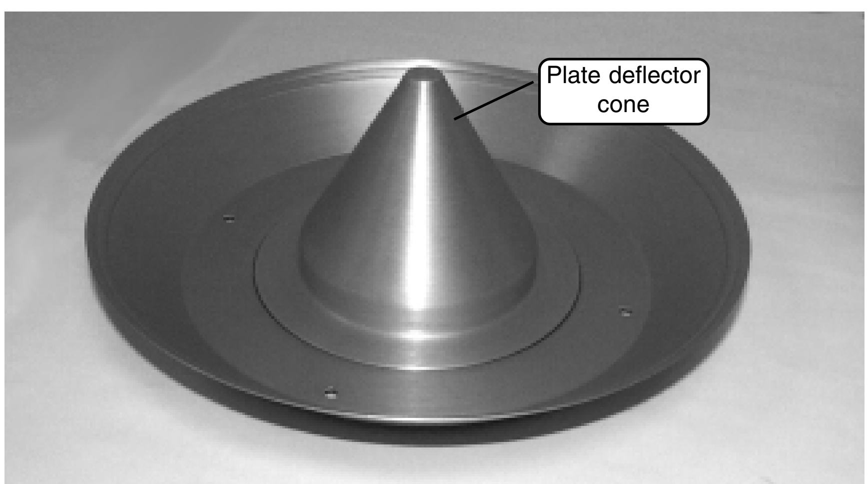
3) Remove and inspect the insect screen for contamination (Figure G-4). Clean the screen by lifting it off the lower plate rain deflector and brushing or rinsing it with water until it is clean. Then allow the screen to dry.

Figure G-4. Removing the insect screen.



4) Using a general-purpose cleaner and paper towel, clean the top plate deflector cone (Figure G-5).

Figure G-5. Top plate with plate deflector cone highlighted.



5) Clean the internal wall surface of the acceleration assembly (Figure G-6).

NOTE: Be sure that after cleaning the assembly the acceleration nozzle is clean. If not, use a cotton swab and cleaner to remove any contamination (Figure G-7).

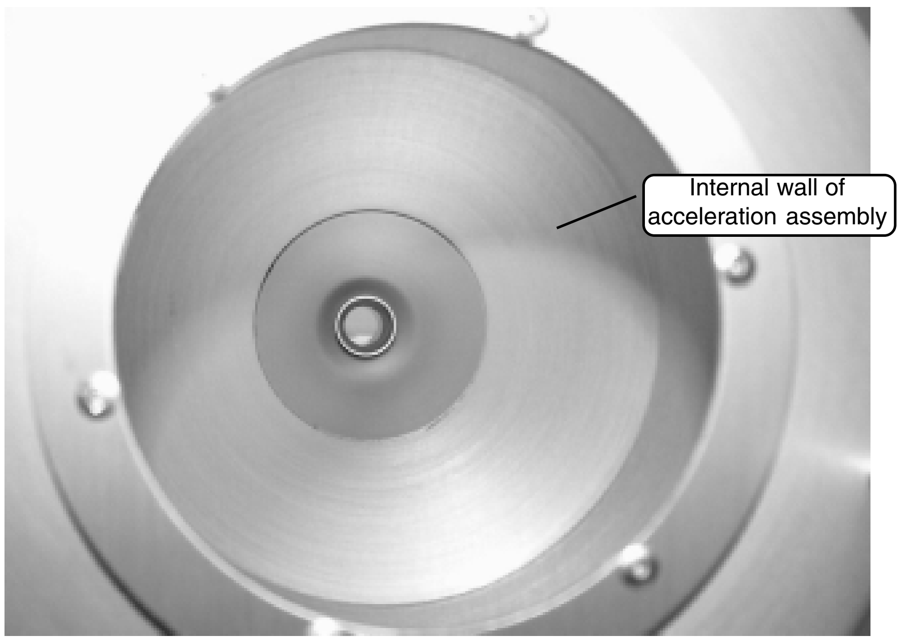


Figure G-6. Acceleration assembly with internal wall highlighted.

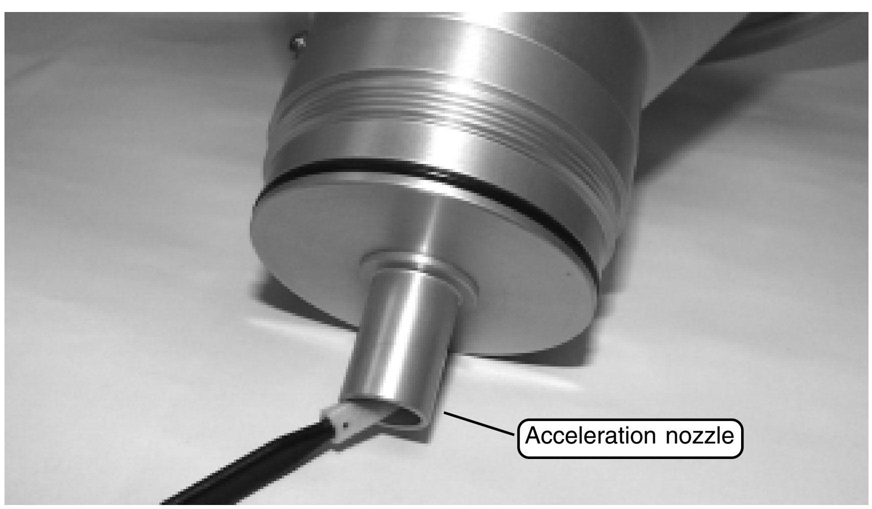


Figure G-7. Cleaning the acceleration nozzle with a cotton swab and cleaner.

6) Inspect the large diameter, impactor nozzle O-ring for damage or wear. Replace it, if necessary. If the O-ring is still in good condition, apply a thin film of silicone grease to the O-ring. Also, apply a light coating of silicone grease to the aluminum threads of the acceleration assembly (Figure G-8).

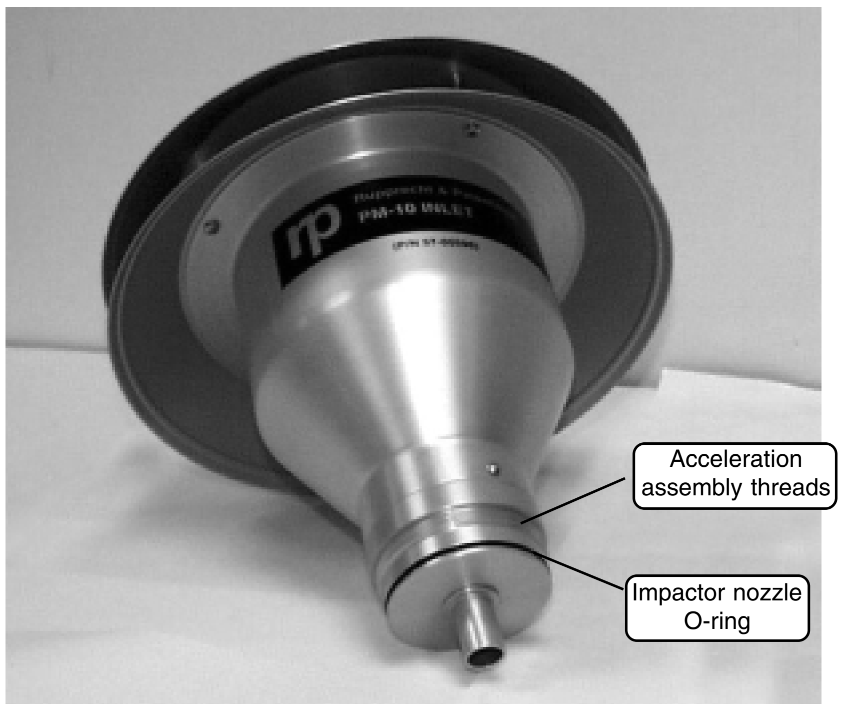


Figure G-8. Acceleration assembly with O-ring and threads highlighted.

7) Reinstall the insect screen and align the top plate markings with the lower plate markings. The four holes in the top plate should align with the four spacer standoffs. Install the top plate onto the lower plate and tighten the four pan-head screws (Figure G-3).

G.1.3. Cleaning the Lower Collector Assembly

Follow these steps to clean and maintain the lower collector assembly:

NOTE: Most of the contamination in the inlet is usually found on the collector plate.

1) Using a general-purpose cleaner with a paper towel, clean the collector assembly walls and plate (Figure G-9).

Figure G-9. Inside of bottom of inlet assembly with collector plate highlighted.

2) Clean the three vent tubes. You may need to use a cotton swab to clean these vent tubes (Figure G-10).

Figure G-10. Cleaning the vent tubes of the lower inlet assembly.

3) Clean the bottom side of the collector assembly (Figure G-11).

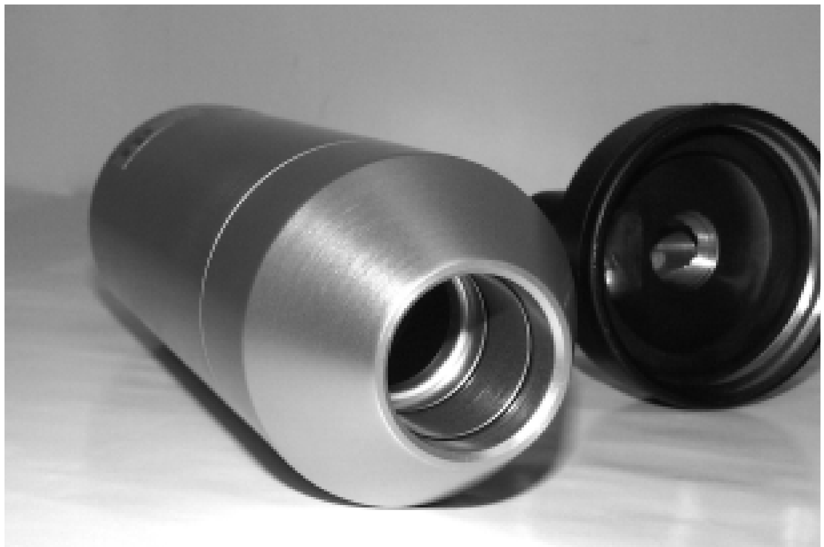


Figure G-11. Bottom of the collector assembly.

4) Using a cotton swab, clean the weep hole in the collector plate where the moisture runs out to the moisture trap (Figure G-12).

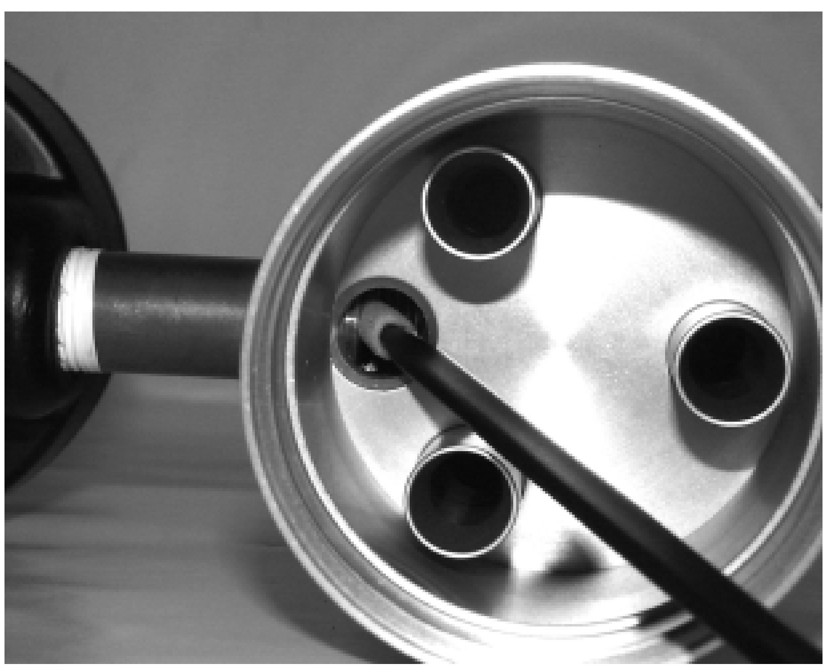
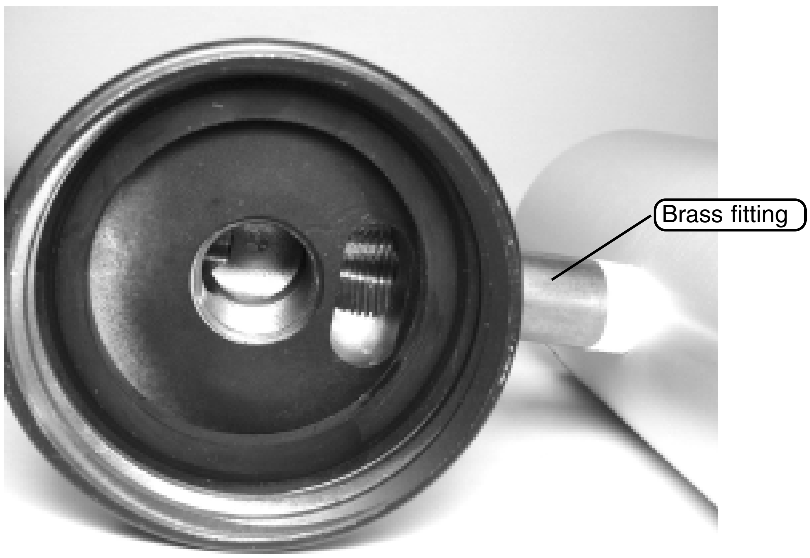


Figure G-12. Cleaning the weep hole in the collector plate.

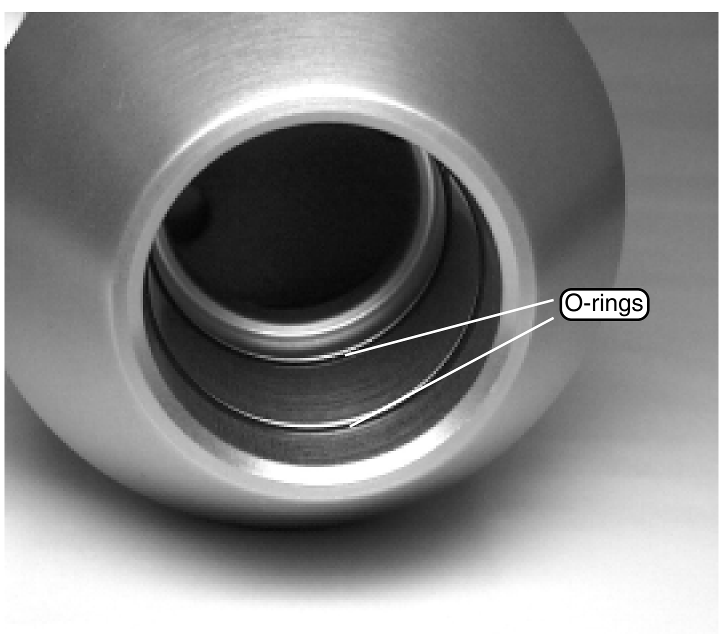
5) **Locate the rain jar (Figure G-1) and clean it. Inspect the rain jar cover's brass nipple fitting to ensure that it is secure and free from blockages (Figure G-13).**

Figure G-13. Rain jar cover with brass fitting highlighted.



6) **Inspect the two inlet tube-sealing O-rings for damage or wear. If necessary, replace the O-rings (Figure G-14).**

Figure G-14. Bottom of inlet with O-rings highlighted.



7) Apply a light coating of silicone grease to the O-rings to ensure that a seal is made when they are reinstalled on the flow splitter.

8) Clean the lower collector assembly's threads to ensure a tight seal when the two halves are reassembled.

9) Place a light coating of silicone grease on the gasket inside the cap of the rain jar. This will ensure a leak-free fit. Reinstall the rain jar.

G.1.4. REINSTALLING THE INLET

Follow these steps to reassemble and reinstall the PM-10 inlet:

1) **Reassemble the top and bottom inlet assemblies until the threads tighten. Hand-tighten only.**
2) **Place a light coating of silicone grease on the gasket inside the cap of the rain jar. This will ensure a leak-free fit. Reinstall the rain jar.**
3) **Place the inlet on the flow splitter. Take care not to damage the internal O-rings.**

G.2. Maintenance of Sharp Cut Cyclone (SCC) Inlets

The sharp cut cyclone (SCC) is a second stage inlet and is available in PM-1 (Figure G-15) and PM-2.5 (Figure G-16) configurations. In Series 8500 FDMS Monitor applications, it is used in conjunction with a PM-10 or modified PM-10 inlet (Figure G-17).

Figure G-15. SCC PM-1 inlet.

Figure G-16. SCC PM-2.5 inlet.

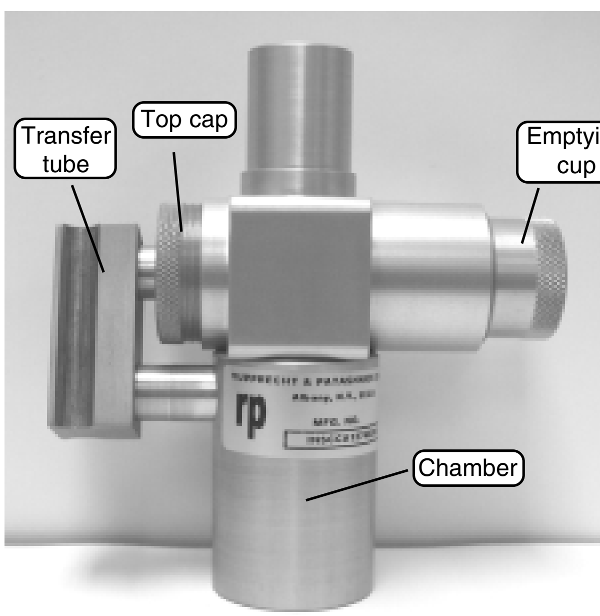
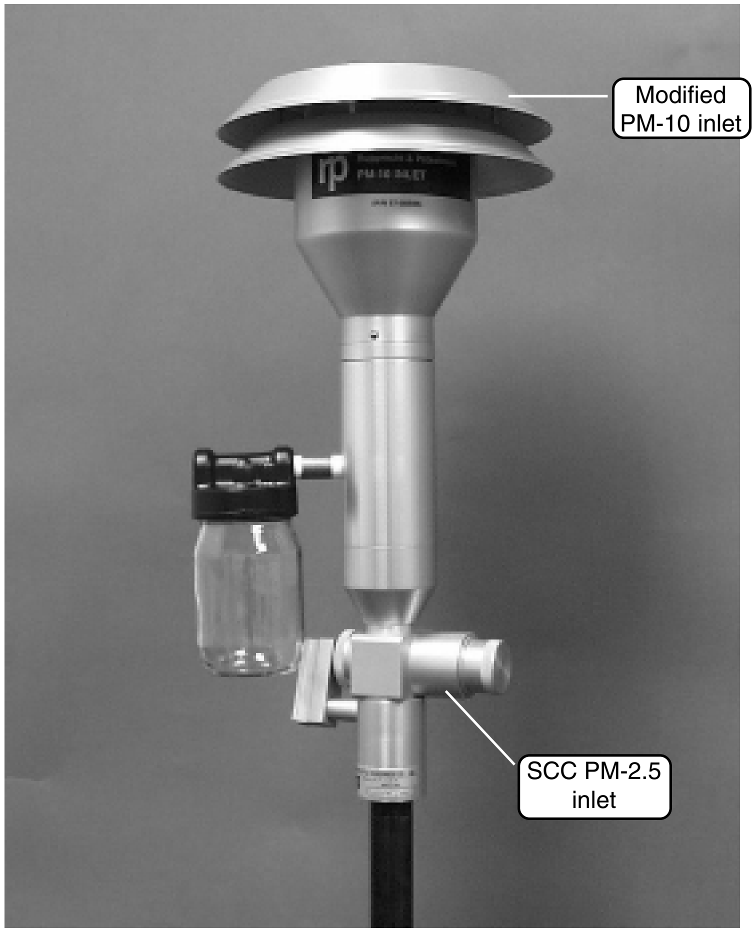


Figure G-17. Modified PM-10 inlet installed onto a sharp cut cyclone (SCC) PM-2.5 inlet.



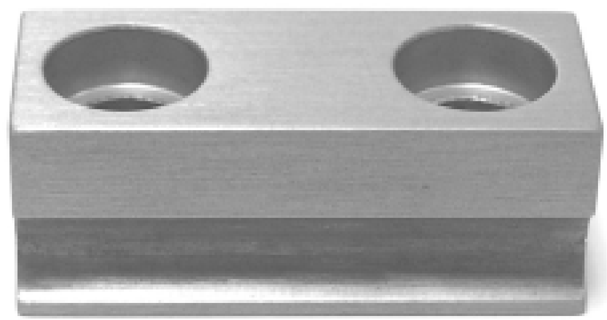
The exact maintenance interval between cleanings of the SCC depends on the particulate matter mass concentration and composition in the ambient air. Field and laboratory experience indicate a required cleaning interval of three to four weeks, or more. Thermo suggests that the user clean the SCC inlet more frequently until operational experience allows better determination of proper cleaning intervals based on your local conditions.

Because the sharp cut cyclone (SCC) PM-1 inlet is similar in construction to the SCC PM-2.5 inlet, the maintenance procedures are the same for both inlets.

Follow these steps to maintain the SCC inlet:

1) **Pull the SCC up and off the flow splitter.**
2) **Pull off the transfer tube (Figures G-16 and G-18). If it is too tight to remove it by hand, pry it off with a rigid plastic lever.**

Figure G-18. SCC transfer tube.



3) **Remove the top cap (Figures G-16 and G-19) and emptying cup (Figures G-16 and G-20) from the chamber (Figures G-16 and G-21).**

Figure G-19. SCC top cap.

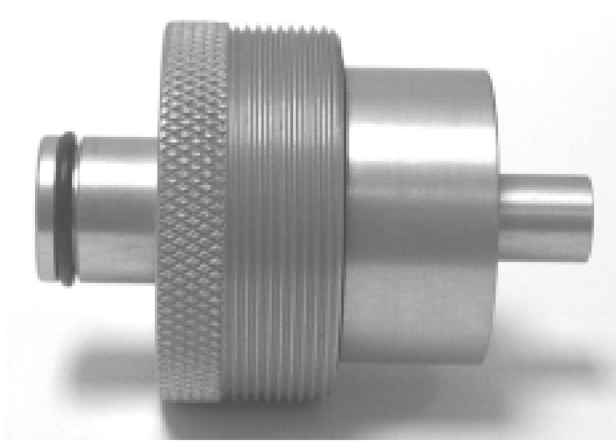


Figure G-20. SCC emptying cup.

Figure G-21. SCC chamber with emptying cup, transfer tube and top cap removed.

4) Wet a lint-free wipe with deionized water and remove all visible deposits. Deposits are most likely to be found in the cone (inside the top cap) and inside the emptying cup.

5) Inspect all O-rings for shape and integrity and replace if necessary. Lubricate all O-rings with light coating of silicone grease. There are 6 O-rings in the SCC, located as follows: 3 on the chamber (2 are located inside the chamber), 2 on the top cap and 1 in the emptying cup.

6) Reassemble and reinstall the SCC onto the flow splitter. Lubricate the transfer tube to aid in reassembly.

NOTE: Refer to the TEOM Series 1400a Monitor Service Manual for further information on maintaining inlets.

Appendix H: Modem Communications

This appendix describes how to connect the Series 8500 FDMS Monitor to a modem for off-site communications and how to set up a serial switching device for use with multiple instruments.

H.1. Setting up a Standard Commercial External Modem

Depending on the configuration of your modem, you may need the following parts:

- Commercial external modem
- 9-to-9 pin RS232 cable
- Null modem adapter (10-005671)
- If your modem has a 25-pin connector — 9-to-25 pin serial adapter (06-005895-0925).

Follow these steps to set up an external commercial modem:

1) **Connect your computer directly to the modem. Follow the instructions that came with the modem.**

2) **Begin executing any communication software that will allow direct communications with the modem. Communication software is included with most modems. If no software program was included with your modem, you can use the Hyper Terminal application (which is included with the Windows operating system).**

3) **Set the modem's communication parameters to work with the Series 8500 FDMS Monitor. The following list contains the commands that should be set and the corresponding command codes. Various commercial modems (especially older modems) may have different command codes for the functions listed. The commands should be replaced with the appropriate codes for your particular modem (consult the modem's instruction manual).**

Communication Parameter	Command Code
Software reset; restore default parameters	&F0
Force DCD (Data Carrier Detect) "ON" at all times	&C0
Ignore DTR (Data Terminal Ready) from instrument	&D0
Set auto answer to 1 ring	S0=1
Set local flow control to "RTS/CTS"	Code varies
Store settings in profile "0"	&W0
Use stored settings in profile "0" on power up	&Y0

4) **Disconnect your computer from the modem.**

5) **Attach the 9-to-9 pin cable to the RS232 connector on the front or back of the monitor.**

6) **Attach the null modem adapter to the other end of the 9-to-9 pin cable.**

   NOTE: Not all null modem adapters can be used in this application because pin connections are not standard. The null modem adapter (10-005671) that is available from R&P is acceptable for use with the FDMS Series 8500 Monitor.

7) **If your modem is equipped with a 9-pin connector, go to step 8. If your modem is equipped with a 25-pin connector, go to step 9.**

8) **Install the null modem adapter onto the 9-pin connector on your modem. Go to step 11.**

9) **Attach a 9-to-25 pin serial adapter to the null modem adapter.**

   NOTE: Not all 9-to-25 pin serial adapters can be used in this application because pin connections are not standard. The 9-to-25 pin serial adapter (06-005895-0925) that is available from R&P is acceptable for use with the FDMS Series 8500 Monitor.

10) **Install the 9-to-25 pin serial adapter onto the 25-pin connector on your modem. Go to step 11.**

11) **Attach a phone line to the modem. The modem is now ready to communicate with the monitor.**

H.2. SETTING UP RPCOMM FOR USE WITH A MODEM

NOTE: The Windows operating system screens shown in this appendix are from the Windows 95 operating system. The screens may vary slightly if you are operating RPComm under other Windows operating systems.

The first two steps of this procedure describe how to set up the unit for direct communication. Direct communication must be successfully completed (Section 10.1) before modem communication is attempted. This will verify that RPComm and the Series 8500 FDMS Monitor have been configured properly. Refer to Section 10 for instructions on obtaining, installing and using RPComm.

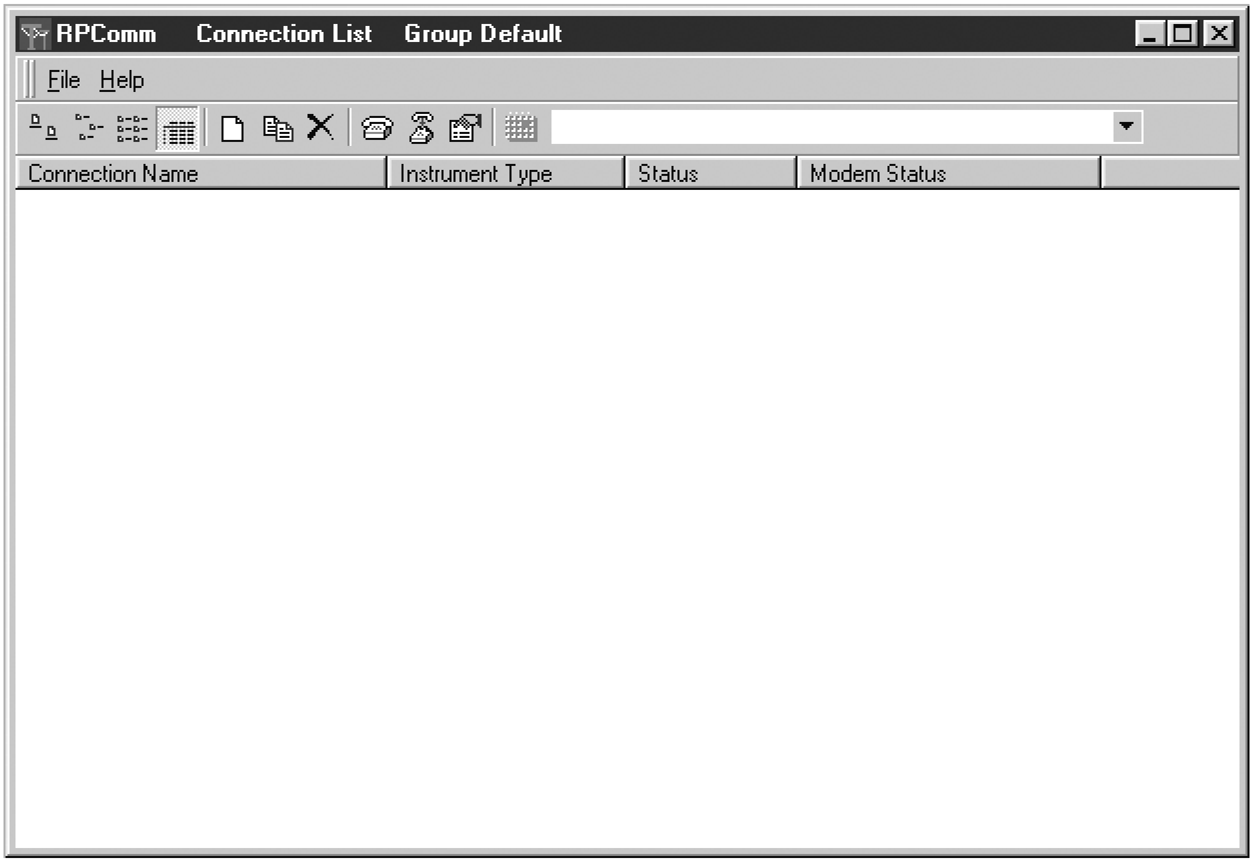
Follow these steps to set up the unit for modem communications:

1) **Set up the Series 8500 FDMS Monitor for direct communications (Section 10.1).**
2) **Create a new direct connection (Section 10.2.2) and verify that the unit is communicating properly.**

   NOTE: If the connection is successful, the unit's serial number will be displayed at the top of the screen. If the connection is not successful, or if there is no unit attached, then the serial number field will be blank or will display "99999."
3) **When the RPComm and instrument configurations have been verified, disconnect the direct connection.**
4) **Set up the unit for modem communications (Section H.1).**

   NOTE: R&P recommends that the modem connections be tested before the unit is placed in the field. The test will require the use of two phone lines.
5) **When in the Connection List screen (Figure H-1), select the name of the connection used to verify the direct connection.**

Figure H-1. Connection List screen.



6) **Select the Edit Selected Connection icon  from the tool bar. The Connection Type screen will display (Figure H-2).**

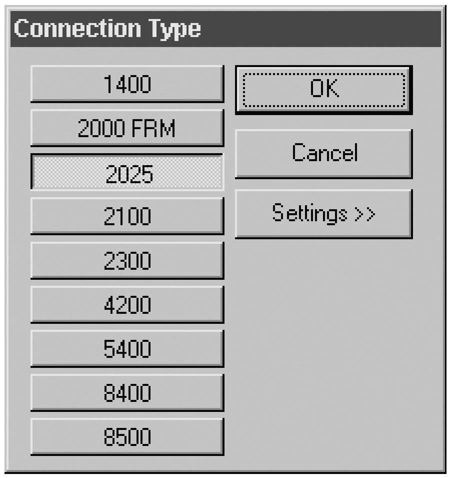


Figure H-2. Connection Type screen.

7) **When in the Connection Type screen, select the “8500” button.**

8) **Select the “Settings” button to display the AK Protocol Setup screen (Figure H-3).**

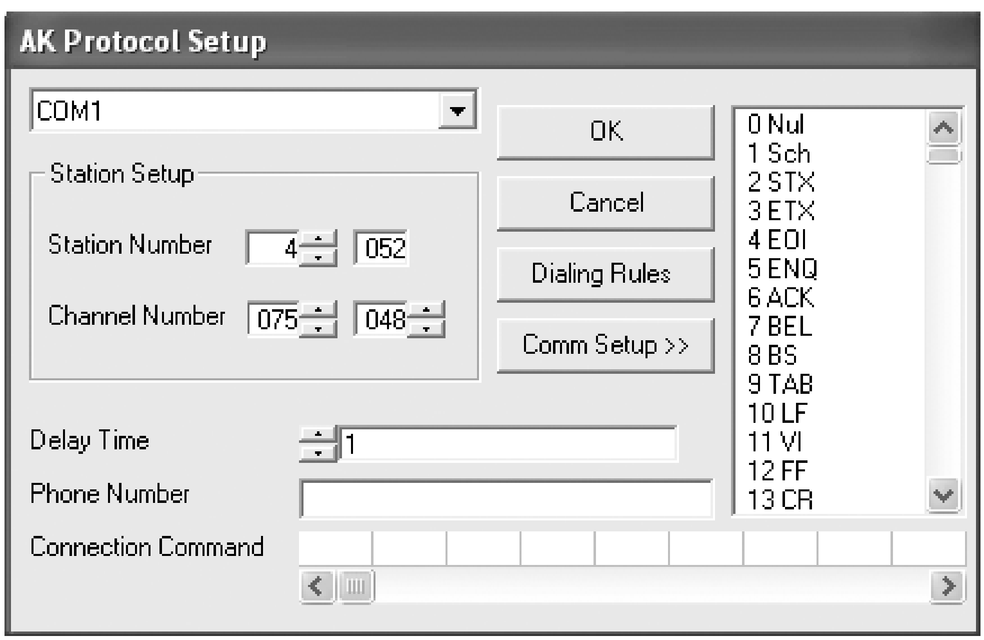
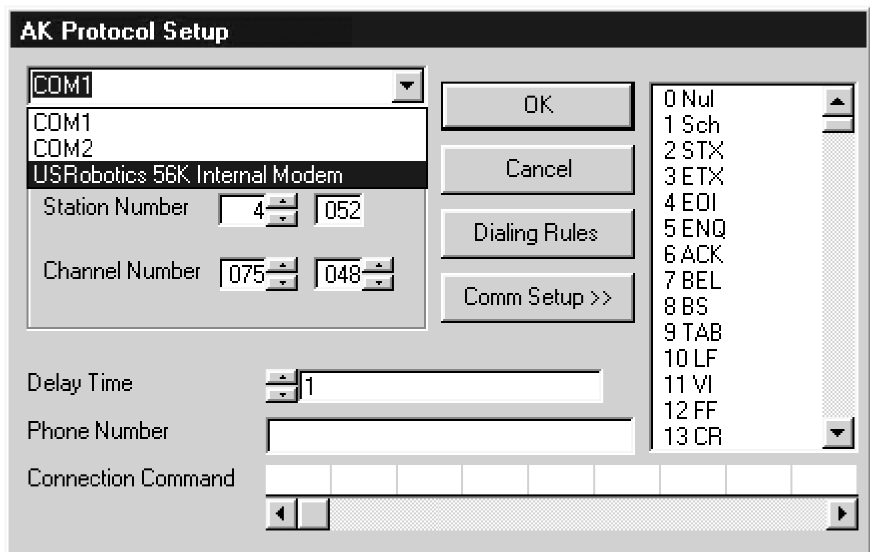


Figure H-3. AK Protocol Setup screen.

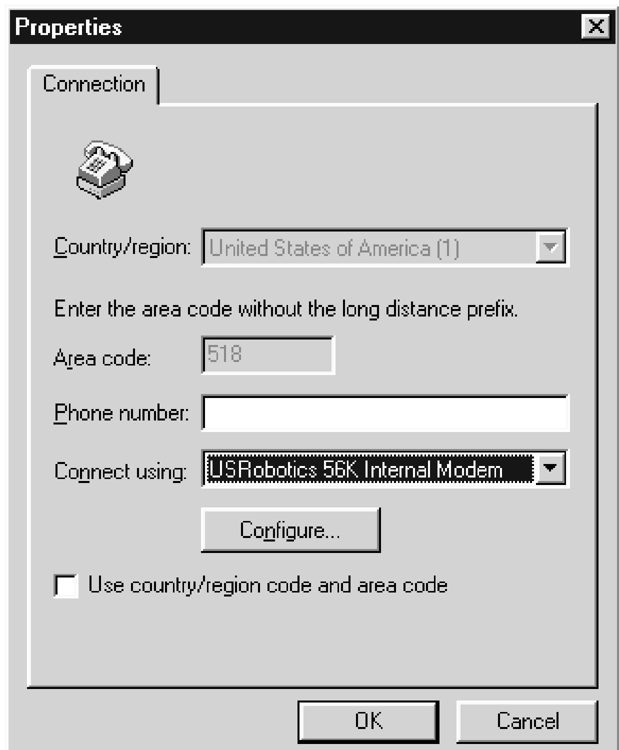
9) **When in the AK Protocol Setup screen, place your cursor on the small black “down” arrow located to the right of the white box in the top, left-hand corner of the screen. A menu will display (Figure H-4). Select the appropriate modem connection listed.**

Figure H-4. AK Protocol Setup screen with menu displayed.



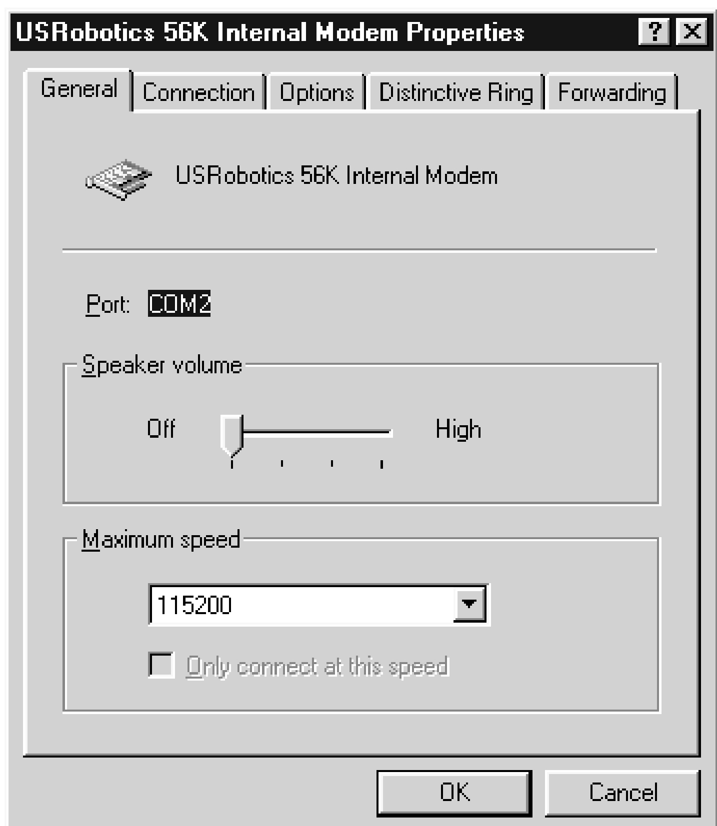
10) When the appropriate modem connection is displayed in the top, left-hand corner of the AK Protocol Setup screen, select the “Comm Setup>” button (Figure H-4). The Properties screen will display (Figure H-5).

Figure H-5. Properties screen.



11) **When in the Properties screen, select the "Configure...." button. The Modem Properties screen will now display with the modem type displayed in the blue bar at the top of the screen (Figure H-6). Generally, the values that your system chooses for variables on this screen are appropriate for a proper connection. However, if your unit and modem experience communication difficulties, these settings may need to be altered. Setting the "Maximum speed" variable to the baud rate of the Series 8500 FDMS Monitor generally solves any communications problems. Contact your modem's manufacturer for more information, if necessary.**

Figure H-6. Modem Properties screen.



12) **Select the "OK" button to exit the Modem Properties screen. The Properties screen (Figure H-5) will now appear as the active screen on your computer.**

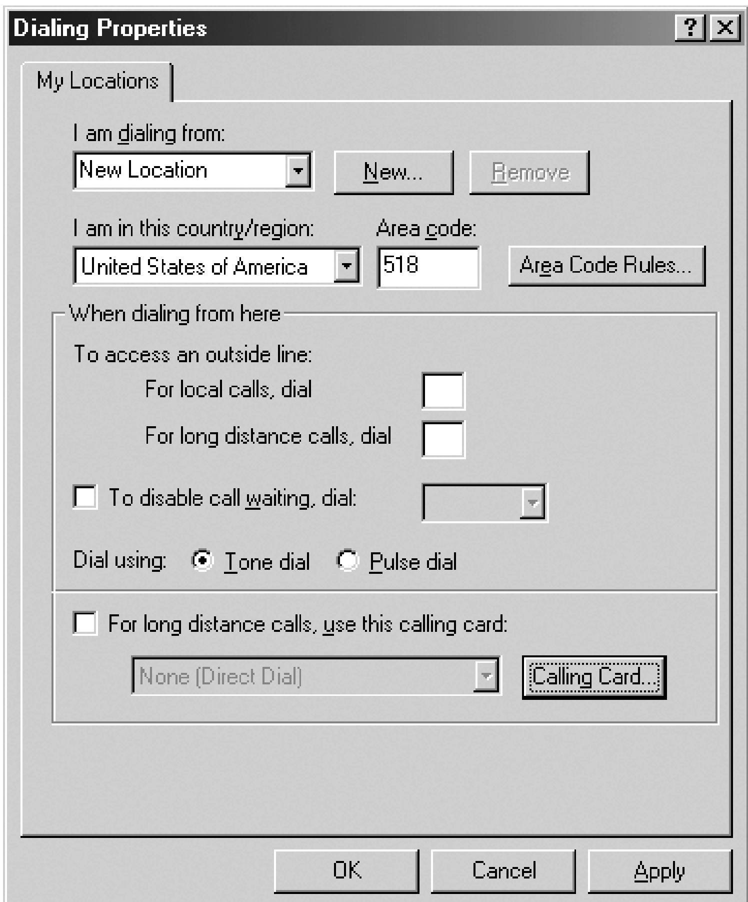
13) **Select the "OK" button to exit the Properties screen. The AK Protocol Setup screen (Figure H-4) will now appear as the active screen on your computer.**

14) When in the AK Protocol Setup screen, enter the phone number to be called in the "Phone Number" box at the bottom of the screen. Enter the phone number as you would write it (i.e., (XXX) XXX-XXXX).

NOTE: Phone numbers should be entered with country codes, city or area codes and then the phone number. For the U.S., you would enter +1 (XXX) XXX-XXXX.

15) When in the AK Protocol Setup screen, select the "Dialing Rules" button. The Dialing Properties screen will display (Figure H-7).

Figure H-7. Dialing Properties screen.



16) Ensure that the dialing rules are correct for your telephone system and area code.

17) Select the "OK" button to exit the Dialing Properties screen. The AK Protocol Setup screen (Figure H-3) will now appear as the active screen on your computer.

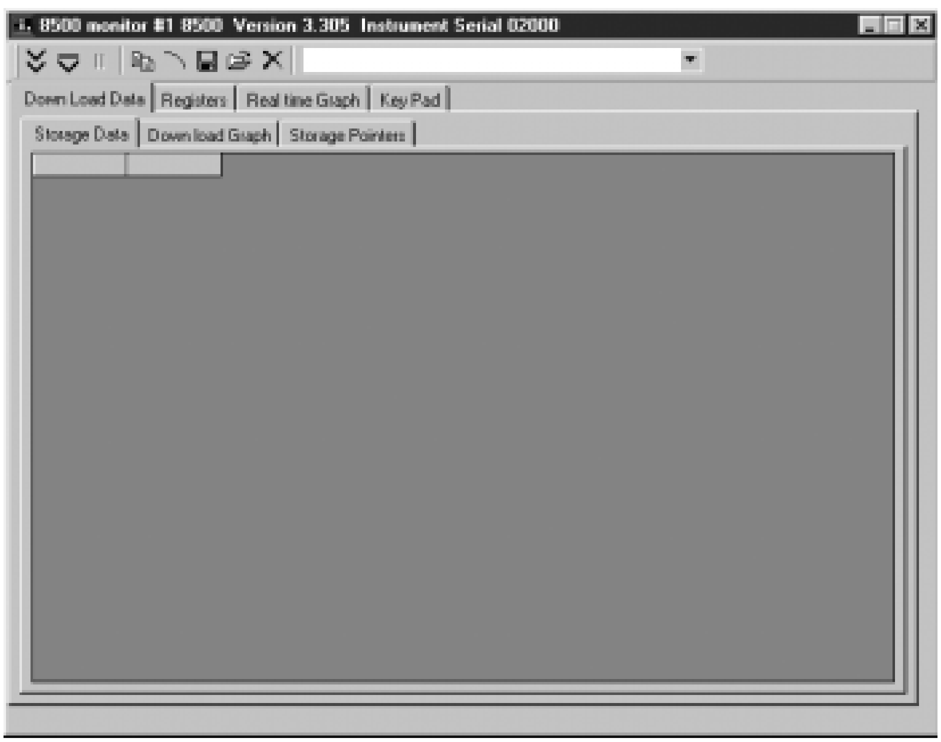
18) When in the AK Protocol Setup screen, select the "OK" button. The Connection Type screen (Figure H-2) will now appear as the active screen on your computer

19) When in the Connection Type screen, select the "OK" button.

20) To connect to your Series 8500 FDMS Monitor through the modem, highlight the connection name on the Connection List screen (Figure H-1) and then select the Connection icon  on the tool bar. The modem connection will now be initiated. When communication is established, the Download Data screen will be displayed (Figure H-8).

NOTE: If the connection is successful, the unit's serial number will be displayed at the top of the screen. If the connection is not successful or if there is no instrument attached, then the serial number will be blank or will display "99999." If the modem loses its connection, wait at least 1 minute before trying to establish another connection. This allows the modem to reset itself.

Figure H-8. Download Data screen.



21) RPComm can now be used as described in Section 10.

H.3. Setting up the Serial Switching Device

For applications where two or more R&P instruments are installed at the same site, a serial switching device can be installed to allow communications with each instrument (including non-R&P serial devices) using one phone line. The serial switching device enables communication to occur with multiple instruments (including non-R&P serial devices) with the use of only one phone line. Command codes can be sent over the phone line to trigger a particular serial port and, therefore, allow communication with the connected instrument. RPComm can be configured to operate with these devices and send the required command codes.

H.3.1. Multiple R&P Instruments of the Same Model

Refer to this section if you are connecting two or more R&P instruments of the same model to a serial switching device.

Follow these steps to set up a serial switching device:

1) **Set up the unit for modem communications (Section H.1). Verify that modem communications to each instrument are successful before adding the serial switching device.**
2) **Obtain a serial switching device from a commercial manufacturer. R&P has found that devices manufactured by Black Box Corp. work well with its instrumentation, although other devices also should function properly. The part number and cost of the device will vary depending on how many serial devices the user wishes to connect to it.**
3) **From the serial switching device's documentation, determine the command codes required to activate each serial port being used.**
4) **Unplug the serial cable, and its adapter(s), from the modem and plug the cable assembly into the serial switching device. Follow the instructions provided with the serial switching device and connect it to the modem.**

   NOTE: R&P recommends that the serial switching device's connections be tested before the unit is placed in the field. This test requires the use of two phone lines.
5) **When in the Connection List screen (Figure H-1), select the name of the connection used to verify the modem connection above and then select the Edit Selected Connection icon  on the tool bar. The Connection Type screen will display (Figure H-2).**

6) **When in the Connection Type screen, ensure that the correct instrument type is selected and select the "Settings" button to display the AK Protocol Setup screen (Figure H-3).**

7) **Examine the list of command codes on the right-hand side of the AK Protocol Setup screen. Select the correct series of command codes needed to trigger the desired instrument. As codes are chosen, they will appear on the bottom of the screen in the Connection Command box. If a code is entered incorrectly, the user can delete the incorrect code by selecting the code in the Connection Command box and pressing the "Delete" key on your computer's keyboard.**

8) **The remaining portions of the screen should have been set while establishing the modem connection (step 1). Do not modify these settings.**

9) **Select the "OK" button to exit the AK Protocol Setup screen. The Connection Type screen will display (Figure H-2).**

10) **When in the Connection Type screen, select the "OK" button to finish the connection setup.**

11) **To initiate a modem connection to a selected instrument, highlight the connection name on the Connection List screen (Figure H-1) and select the Connection icon  on the tool bar. The connection to the instrument will be initiated and the proper command codes will be sent to the serial switching device. When communication is established, the Download Data screen will display (Figure H-7).**

NOTE: If the connection is successful, the unit's serial number will be displayed at the top of the screen. Ensure that the correct serial number is displayed to verify that the proper command codes were sent and that the serial port trigger is functioning properly. If the connection is not successful or if there is no instrument attached, then the serial number will be blank or will display "99999". If the modem loses its connection, wait at least 1 minute before trying to establish another connection. This allows the modem to reset itself.

12) **RPComm can now be used as described in Section 10.**

13) **To connect to a different instrument through the serial switching device, the current connection must be terminated. Select the Disconnect icon  on the tool bar to terminate the current connection.**

14) **Enter the proper command codes for the desired instrument as described in step 7 and initiate the modem connection as explained in step 11. If the modem loses its connection, wait at least 1 minute before trying to establish another connection. This allows the modem to reset itself.**

H.3.2. Multiple R&P Instruments of Different Models

Refer to this subsection if two or more R&P instruments of different models are being connected to a serial switching device. The following combinations involving the Series 8500 FDMS Monitor can be supported at this time:

Series 8500 and a Series 1400a
Series 8500 and a Model 2025
Series 8500 and a Series 5400 Monitor

Although RPComm supports both the Series 8500 and the Model 2000-FRM monitors, it is not possible to connect these instruments to a single serial switching device. This is because the Series 8500 FDMS Monitor requires the local communication flow control to be set to "RTS/CTS" and the Model 2000-FRM sampler does not support any local communication flow control.

If a Series 8500 and a Model 2000-FRM are located at the same site, two modems and phone lines are necessary for communication with the two instruments.

H.3.2.1. Connecting a Series 8500 FDMS Monitor and Other R&P Instruments of Different Models

Follow these steps to connect a Series 8500 FDMS Monitor and another R&P instrument via a serial switching device:

1) **Set up the Series 8500 FDMS Monitor and the other instrument for direct communications (Section 10).**
2) **Create a new connection to each instrument according to Section 10.2.2 and verify that the units are communicating properly.**

   NOTE: If the connection is successful, the unit's serial number will be displayed at the top of the screen. If the connection is not successful or if there is no unit attached, then the serial number will be blank or will display "99999."
3) **Once the RPComm software and instrument configurations have been verified, disconnect the direct connection.**
4) **Connect your computer directly to the modem that will be connected to the serial switching device (follow the modem's instruction manual).**
5) **Begin executing any communication software that will allow direct communications with the modem. Communication software is usually included with most standard commercial**

modems. If no software program was included with your modem, you can use the Hyper Terminal application (which is included with the Windows operating system).

6) **Set the modem's communication parameters to work with the Series 8500 FDMS Monitor. The following list contains the commands that should be set and the corresponding command codes. Various commercial (especially older) modems may have different command codes for the functions listed. Consult your modem's instruction manual for proper commands.**

Communication Parameter	Command Code
Software reset; restore default parameters	&F0
Force DCD (Data Carrier Detect) "ON" at all times	&C0
Ignore DTR (Data Terminal Ready) from instrument	&D0
Set auto answer to 1 ring	S0=1
Set local flow control to "RTS/CTS"	Code varies
Store settings in profile "0"	&W0
Use stored settings in profile "0" on power up	&Y0

7) **Once the connection has been verified, disconnect your computer from the modem.**

8) **Attach the 9-to-9 pin cable to the RS232 connector on the front or back of the monitor.**

9) **Attach the null modem adapter to the other end of the 9-to-9 pin cable.**

NOTE: Not all null modem adapters can be used in this application because pin connections are not standard. The null modem adapter (10-005671) that is available from R&P is acceptable for use with the Series 8500 FDMS Monitor.

10) **If your modem is equipped with a 9-pin connector, go to step 11. If your modem is equipped with a 25-pin connector, go to step 12.**

11) **Install the null modem adapter onto the 9-pin connector on your modem. Go to step 14.**

12) **Attach a 9-to-25 pin serial adapter to the null modem adapter.**

NOTE: Not all 9-to-25 pin serial adapters can be used in this application because pin connections are not standard. The 9-to-25 pin serial adapter (06-005895-0925) that is available from R&P is acceptable for use with the Series 8500 FDMS Monitor.

13) **Install the 9-to-25 pin serial adapter onto the 25-pin connector on your modem. Go to step 14.**

14) **Attach a phone line to the modem. The modem is now ready to communicate with the monitor.**

15) **When in the Connection List screen (Figure H-1), select the name of one of the connections used to verify the direct connection above and choose the Edit Selected Connection icon  on the tool bar. The Connection Type screen will then display (Figure H-2).**

16) **When in the Connection Type screen, ensure that the correct instrument type is selected and select the “Settings” button to display the AK Protocol Setup screen (Figure H-3).**

17) **Place your cursor on the small black “down” arrow located to the right of the white box in the top, left-hand corner of the AK Protocol Setup screen. A menu will display (Figure H-4). Select the appropriate modem connection from the list.**

    NOTE: The Station Setup portion of the screen should have been set when you established your direct connection (Section 10). Do not modify these settings.

18) **When the appropriate modem connection is displayed in the top, left-hand corner of the AK Protocol Setup screen, select the “Comm Setup>” button. The Properties screen will display (Figure H-5).**

19) **When in the Properties screen, select the “Configure....” button. The Modem Properties screen will now display with the modem type displayed in the blue bar at the top of the screen (Figure H-6). Generally, the values that your system chooses for variables on this screen are appropriate for a proper connection. However, if your unit and modem experience communication difficulties, these settings may need to be altered. Setting the “Maximum speed” variable to the baud rate of the Series 8500 FDMS Monitor generally solves any communications problems. Contact your modem’s manufacturer for more information, if necessary.**

20) **Select the “OK” button to exit the Modem Properties screen. The Properties screen (Figure H-5) will now appear as the active screen on your computer.**

21) **Select the “OK” button to exit the Properties screen. The AK Protocol Setup screen (Figure H-4) will now appear as the active screen on your computer.**

22) **When in the AK Protocol Setup screen, enter the phone number to be called in the “Phone Number” box at the bottom of the screen. Enter the phone number as you would write it (i.e., (XXX) XXX-XXXX).**

    NOTE: Phone numbers should be entered with country codes, city or area codes and then the phone number. For the U.S. +1, you would enter (XXX) XXX-XXXX.

23) **When in the AK Protocol Setup screen, select the “Dialing Rules” button. The Dialing Properties will display (Figure H-7).**

24) **Ensure that the dialing rules are correct for your telephone system and area code.**

25) **Select the “OK” button to exit the Dialing Properties screen. The AK Protocol Setup screen (Figure H- 4) will now appear as the active screen on your computer.**

26) **When in the AK Protocol Setup screen, select the “OK” button. The Connection Type screen (Figure H-2) will now appear as the active screen on your computer.**

27) **When in the Connection Type screen, select the “OK” button.**

28) **To connect to your series 8500 FDMS Monitor, highlight the connection name on the Connection List screen (Figure H-1) and then select the Connection icon  on the tool bar. The Modem connection will now be initiated. When communication is established, the Download Data screen (Figure H-8) will display.**

    NOTE: If the connection is successful, the unit’s serial number will be displayed at the top of the screen. If the connection is not successful or if there is no instrument attached, then the serial number will be blank or will display “99999.” If the modem loses its connection, wait at least 1 minute before trying to establish another connection. This allows the modem to reset itself.

29) **After the connection has been verified, disconnect the modem connection to the instrument.**

30) **Connect the modem to the other R&P instrument by attaching the male end of the 9-to-9 pin cable to the RS232 connector on the other instrument.**

31) **Repeat steps 15 through 28 (using appropriate values for the required parameters — refer to your instrument’s Operating Manual) for the other instrument.**

32) **After the connection has been verified, disconnect the modem connection to the instrument.**

33) **Obtain a serial switching device from a commercial manufacturer. R&P has found that devices manufactured by Black Box Corp. work properly with its instrumentation, although other devices should function properly. The part number and cost of the device will vary depending on how many serial devices the user wishes to connect to it.**

34) **From the serial switching device's instruction manual, determine the command codes required to trigger activation of each serial port being used.**

35) **Unplug the serial cable, and its adapter(s), from the modem and plug the cable assembly into the serial switching device. Follow the instructions provided with the serial switching device and connect it to the modem.**

NOTE: R&P recommends that the serial device's connections be tested before the unit is placed in the field. This test will require the use of two phone lines.

36) **When in the Connection List screen (Figure H-1), select the name of one of the connections used to verify the modem connection above and then choose the Edit Selected Connection icon**  **on the tool bar. The Connection Type screen will then display (Figure H-2).**

37) **When in the Connection Type screen, ensure that the correct instrument type is selected and select the "Settings" button to display the AK Protocol Setup screen (Figure H-3).**

38) **Examine the list of command codes on the right-hand side of the AK Protocol Setup screen, and select the correct series of command codes needed to trigger the desired instrument. As the codes are chosen, they will appear on the bottom of the screen in the Connection Command box. If the user enters an incorrect code, they can delete it by selecting the code in the Connection Command box and pressing the "Delete" key on your computer's keyboard.**

39) **The remaining portions of the screen should have been set while establishing the modem connection. Do not modify these settings.**

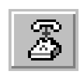
40) **Select the "OK" button to exit the AK Protocol Setup screen. The Connection Type screen will display (Figure H-2).**

41) **When in the Connection Type screen, select the "OK" button to finish the connection setup.**

42) When in the Connection List screen, highlight one of the instruments and select the Connection icon  on the tool bar. The connection to the instrument will be initiated and the proper command codes sent. When communication is established, the Download Data screen will be displayed (Figure H-8).

NOTE: If the connection is successful, the unit's serial number will be displayed at the top of the screen. Ensure that the correct serial number is displayed to verify that the proper command codes were sent and that the serial port trigger is functioning properly. If the connection is not successful or if there is no instrument attached, then the serial number will be blank or will display "99999." If the modem loses its connection, wait at least 1 minute before trying to establish another connection. This allows the modem to reset itself.

43) RPComm can now be used as described in Section 10.

44) To connect to a different R&P instrument through the serial switching device, the current connection must be terminated. Select the Disconnect icon  on the tool bar to terminate the current connection.

45) Enter the proper command codes for the desired instrument as described in step 35 and initiate the modem connection as explained in step 39. If the modem loses its connection, wait at least 1 minute before trying to establish another connection. This allows the modem to reset itself.

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Appendix I: ASCII Codes

The following is a list of ASCII codes that are used in the TEOMCOMM software:

Code	Character
048	0
049	1
050	2
051	3
052	4
053	5
054	6
055	7
056	8
057	9
065	A
066	B
067	C
068	D
069	E
070	F
071	G
072	H
073	I
074	J
075	K
076	L
077	M
078	N
079	O
080	P
081	Q
082	R
083	S
084	T
085	U
086	V
087	W
088	X
089	Y
090	Z

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Appendix J: TEOMCOMM Software

TEOMCOMM is a communications software package which provides interactive remote communication with the Series 8500 FDMS Monitor. The user can use this software application to download data stored in the instrument, and retrieve and set instrument operating parameters remotely.

TEOMCOMM has two communication modes — direct and modem. Direct communication is accomplished when the unit has a direct cable connection with a PC. Modem communication is accomplished when the unit has a connection with a PC through the use of a modem and phone line (Appendix H). Before modem communication is attempted, direct communication must be successfully completed. This will ensure that the PC and unit have been set up properly for communications.

J.1. Installing TEOMCOMM onto a Personal Computer

Follow these steps to install TEOMCOMM onto a PC:

1) **Ensure that your PC is in MS-DOS mode.**
2) **When the MS-DOS prompt displays, enter the following command after the prompt:**

   MD C:\TEOMCOMM

3) **Press Enter.**
4) **Insert the TEOMCOMM 3 1/2" floppy disk into a 3 1/2" disk drive in the computer.**
5) **Enter the following command after the MS-DOS prompt:**

   COPY X:TEOMCOMM.* C:\TEOMCOMM

   NOTE: The "X" represents the letter of your PC's 3 1/2" disk drive.

6) **Press Enter. The PC will now copy the files named "TEOMCOMM.EXE" and "TEOMCOMM.CFG" onto its hard drive.**

J.2. TEOMCOMM Setup

Before you connect your monitor to a PC (Section J.6), you must start the TEOMCOMM software program (Section J.2.1) and set TEOMCOMM's communication parameters (Section J.2.2).

J.2.1. Starting TEOMCOMM

Follow these steps to begin running the TEOMCOMM software program:

1) **Ensure that your PC is in MS-DOS mode.**
2) **When the MS-DOS prompt displays, press Enter.**
3) **When the MS-DOS prompt displays again, enter the following command after the prompt:**

   CD \TEOMCOMM

4) **Press Enter.**
5) **If you want to run TEOMCOMM with a monochrome monitor, go to step 6. If you want to allow a time delay while running TEOMCOMM, go to step 8. If you want to create a "SESSION.LOG" file for debugging purposes, go to step 10. If you simply want to begin running the TEOMCOMM software program, go to step 12.**
6) **When the MS-DOS prompt displays, enter the following command after the prompt:**

   TEOMCOMM /M

7) **Press Enter.**
8) **When the MS-DOS prompt displays, enter the following command after the prompt:**

   TEOMCOMM /T #

   NOTE: The "#" is the number of seconds that you want to allow for the time delay. The default setting for the monitor is 0.5 seconds.

9) **Press Enter.**
10) **When the MS-DOS prompt displays, enter the following command after the prompt:**

   TEOMCOMM /D

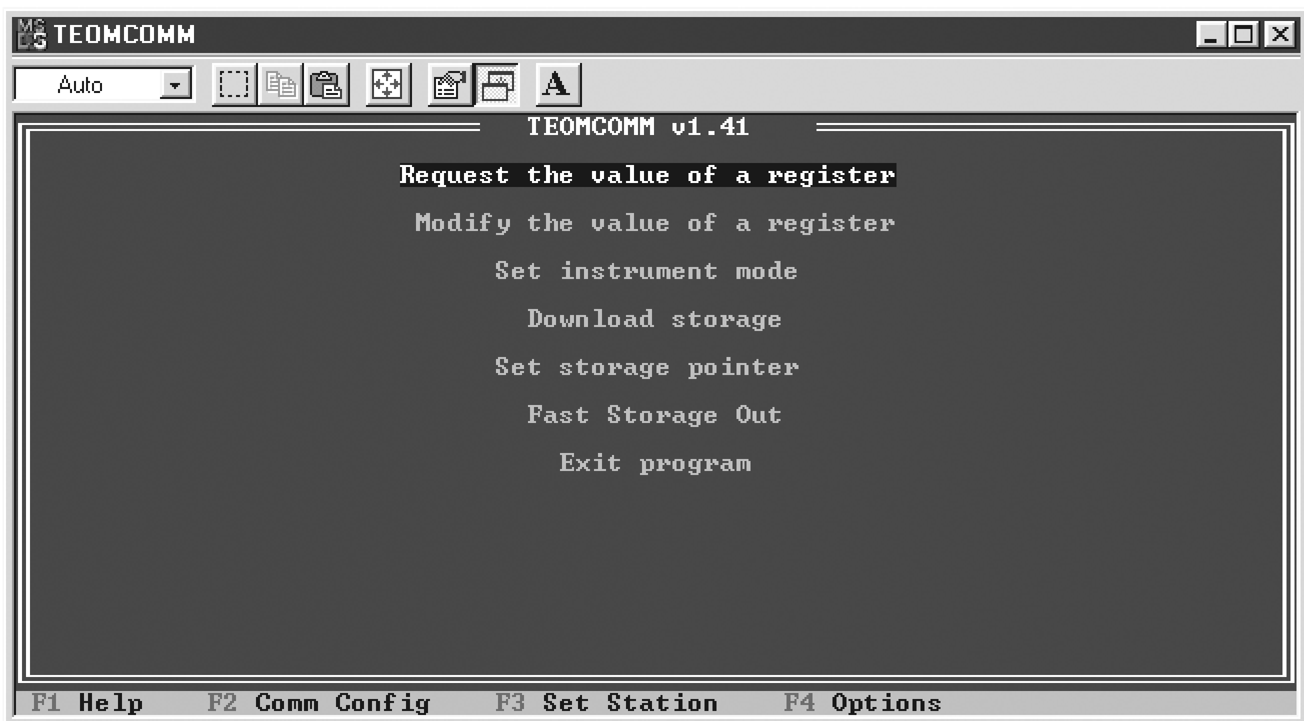
11) Press Enter.

12) When the MS-DOS prompt displays, enter the following command after the prompt:

TEOMCOMM

13) Press Enter. The TEOMCOMM Main screen (Figure J-1) (Section J.3) will now display.

Figure J-1. TEOMCOMM Main screen.

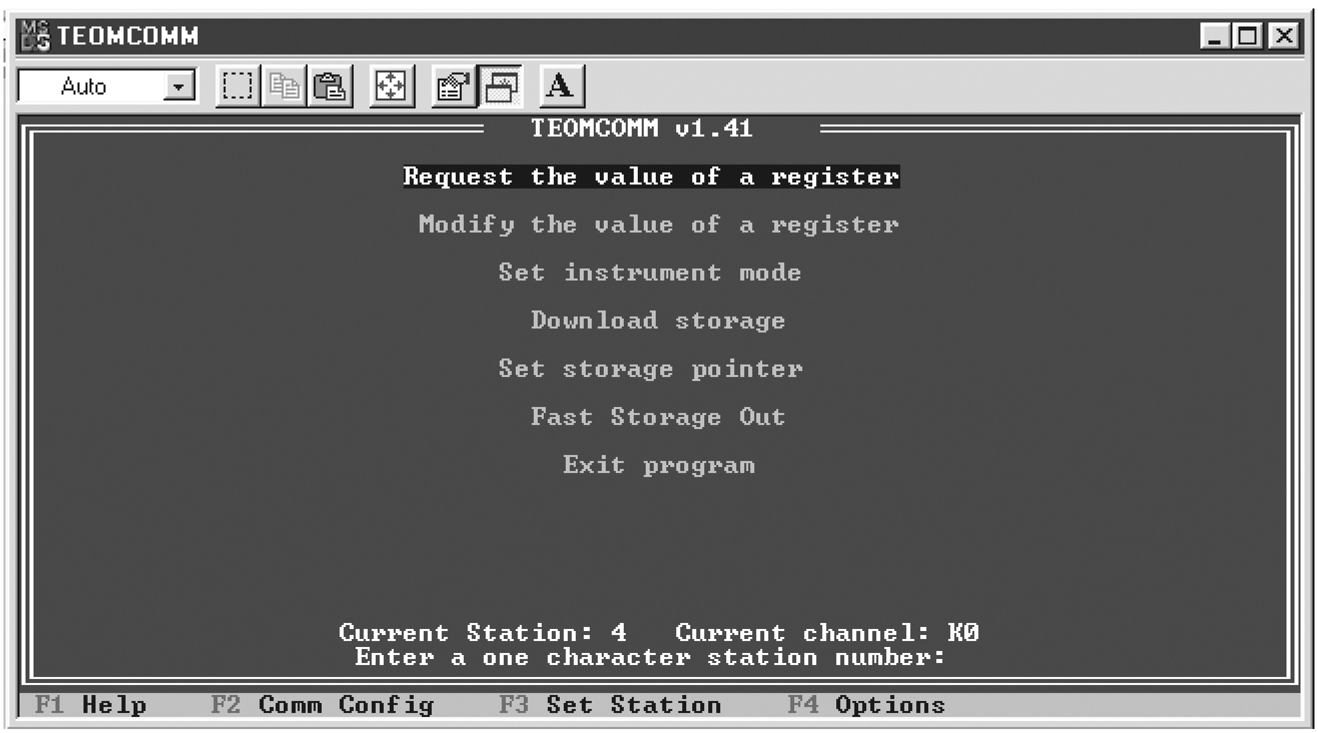


J.2.2. Setting the Communication Parameters

Follow these steps to set TEOMCOMM's communication parameters:

1) **Ensure that your PC is in MS-DOS mode.**
2) **Begin running the TEOMCOMM software program (Section J.2.1).**
3) **When in the TEOMCOMM Main screen (Figure J-1), press the "F3" key on the PC's keyboard to view the "Set Station" parameters currently stored in the program. The PC will display the alphanumeric settings for the station number (RS-Para 1) and channel number (RS-Para 2) (Figure J-2).**

Figure J-2. TEOMCOMM Main screen with Set Station parameters displayed.



4) The TEOMCOMM program will prompt the user to enter a new station number and channel number. Enter “4” for the station number and “K0” for the channel number.

NOTE: All alphabetic letters must be capitalized. Ensure that the letter “K” is followed by a zero (“0”), not the letter “O”.

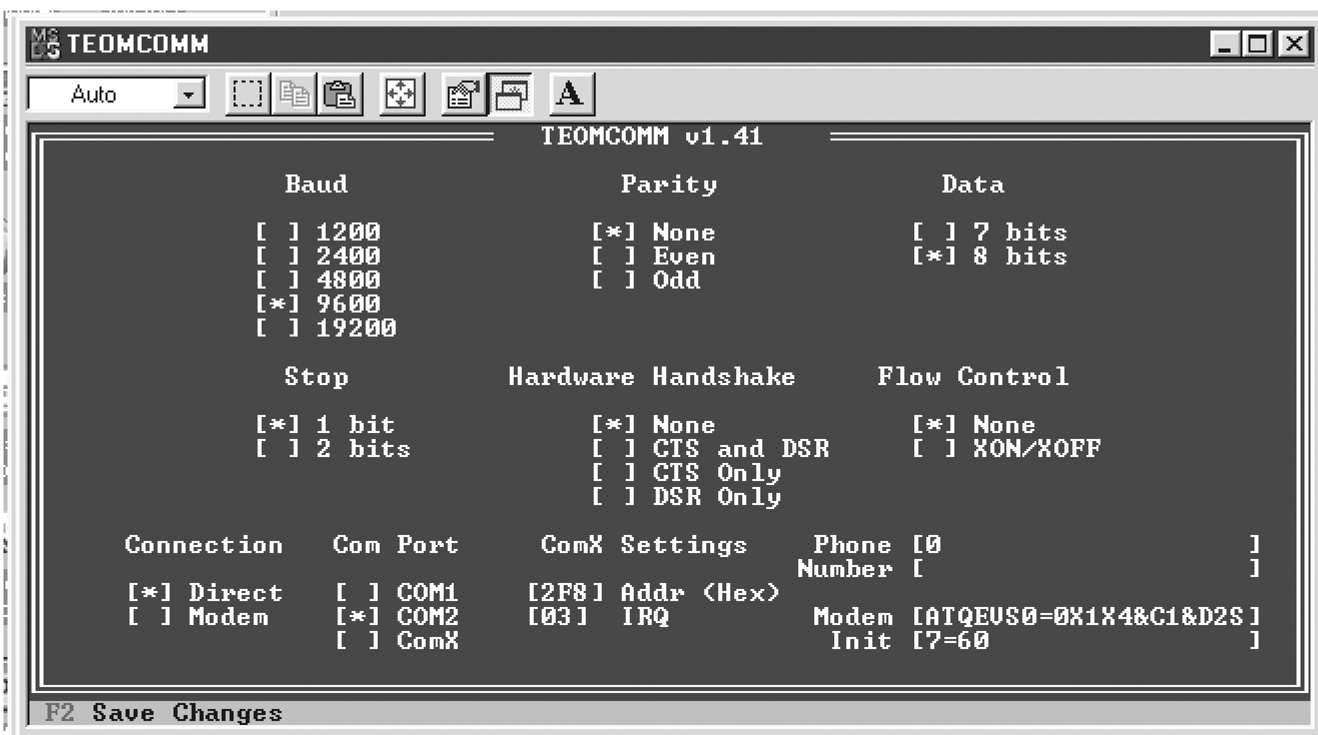
5) Press Enter.

6) Press F2 to display the TEOMCOMM Communications Setup screen (Figure J-3).

✔ The communication parameters of the FDMS Series 8500 monitor and the TEOMCOMM software must match in order for the computer to communicate properly with the monitor.

NOTE: The original configuration of the TEOMCOMM software should match the default settings of the monitor. If you want to connect the monitor to a PC through a modem, you may need to change the settings of the “Baud,” “Connection,” “Com Port,” and “Phone” fields.

Figure J-3. TEOMCOMM Communications Setup screen.



7) Ensure that the communication parameters are set properly for direct or modem communications (Section J.4) depending on your setup. If you want to change the communication parameters, go to step 8. If you do not want to change the communication parameters, go to step 11.

8) Press the right and left arrow keys to move the cursor to the desired parameter field.

9) Press the up and down arrow keys to select the appropriate communication parameter.

10) Press the spacebar to select the new value for the communication parameter. An asterisk "*" will appear in the brackets ("[ ]") next to the newly selected communication parameter.

11) Press F2. The TEOMCOMM Main screen (Figure J-1) will now display.

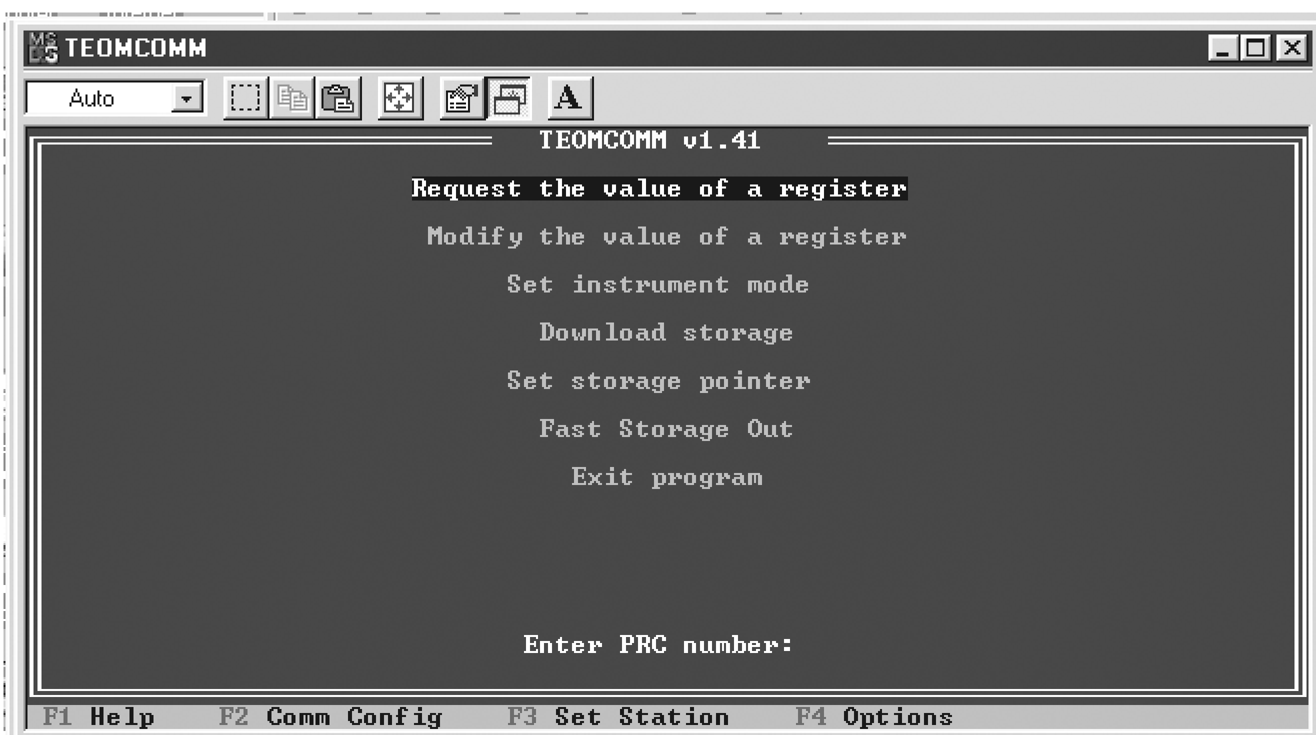
J.3. TEOMCOMM Main Screen

The TEOMCOMM Main screen (Figure J-1) contains a list of commands that are available in the TEOMCOMM software. Press the up and down arrow keys to select the appropriate command, and then press Enter. After you press Enter, the computer will prompt you for any additional information that may be required for the selected command.

J.3.1. Request the Value of a Register

This command returns the value of a requested system variable. When the user selects this command, the computer will request the variable's PRC (Appendix B) (Figure J-4). After the user enters the appropriate PRC, the personal computer (PC) will display the current value of the variable.

Figure J-4. TEOMCOMM Main screen with request for PRC number displayed.



J.3.2. Modify the Value of a Register

This command modifies the value of a system variable. When the user selects this command, the computer will request the PRC (Appendix B) of the variable to be changed at the bottom of the screen(Figure J-5).

Figure J-5. TEOMCOMM Main screen with request for PRC number displayed.

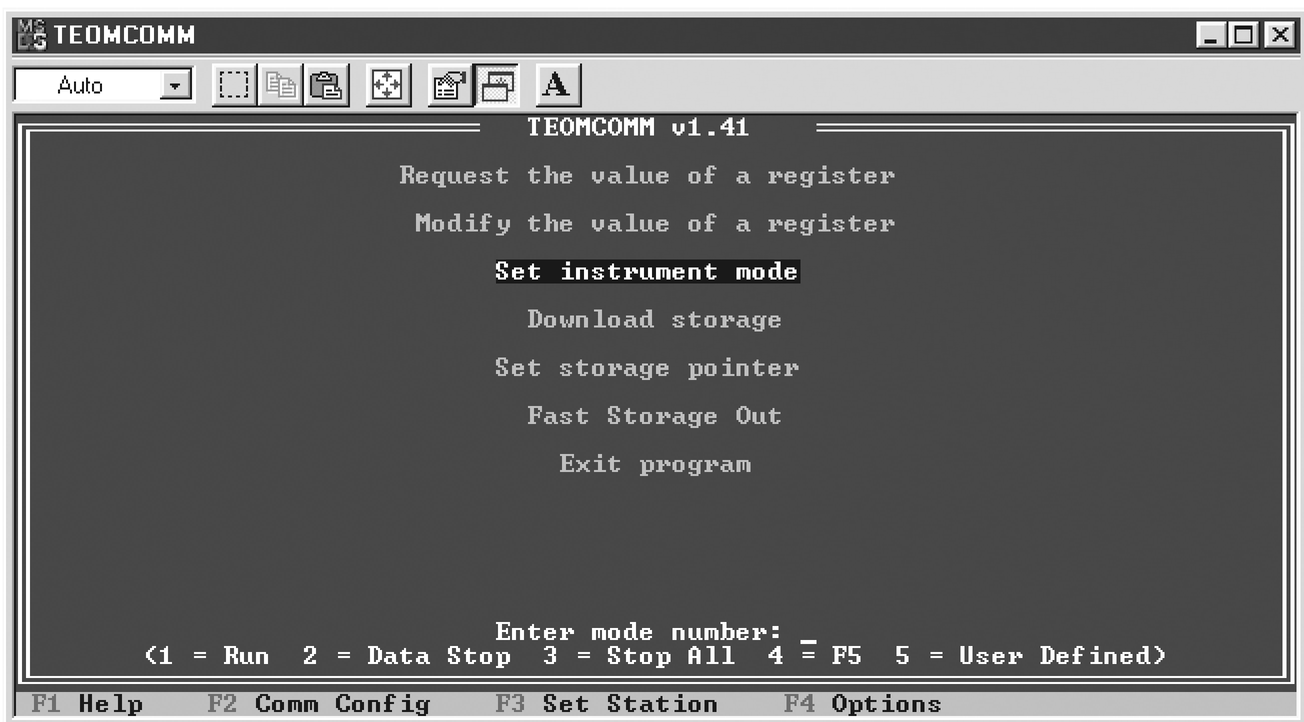
After the user enters the appropriate PRC, the computer will request the new value (Figure J-6) at the bottom of the screen. After the user enters the new value, the personal computer (PC) will display a confirmation message showing the PRC and the new value that will be stored in the monitor. Some parameters can be changed only when the monitor is in the Setup Mode (Section J.3.3).

Figure J-6. TEOMCOMM Main screen with request for value of PRC number displayed.

J.3.3. Set Instrument Mode

This command allows the user to change the Operating Mode of the monitor. When the user selects this command, the PC will request the new Operating Mode (Figure J-7).

Figure J-7. TEOMCOMM Main screen with request for new operating mode displayed.



After the user enters the appropriate value for the new Operating Mode, the PC will display a confirmation message that states that the instrument's Operating Mode has been successfully changed.

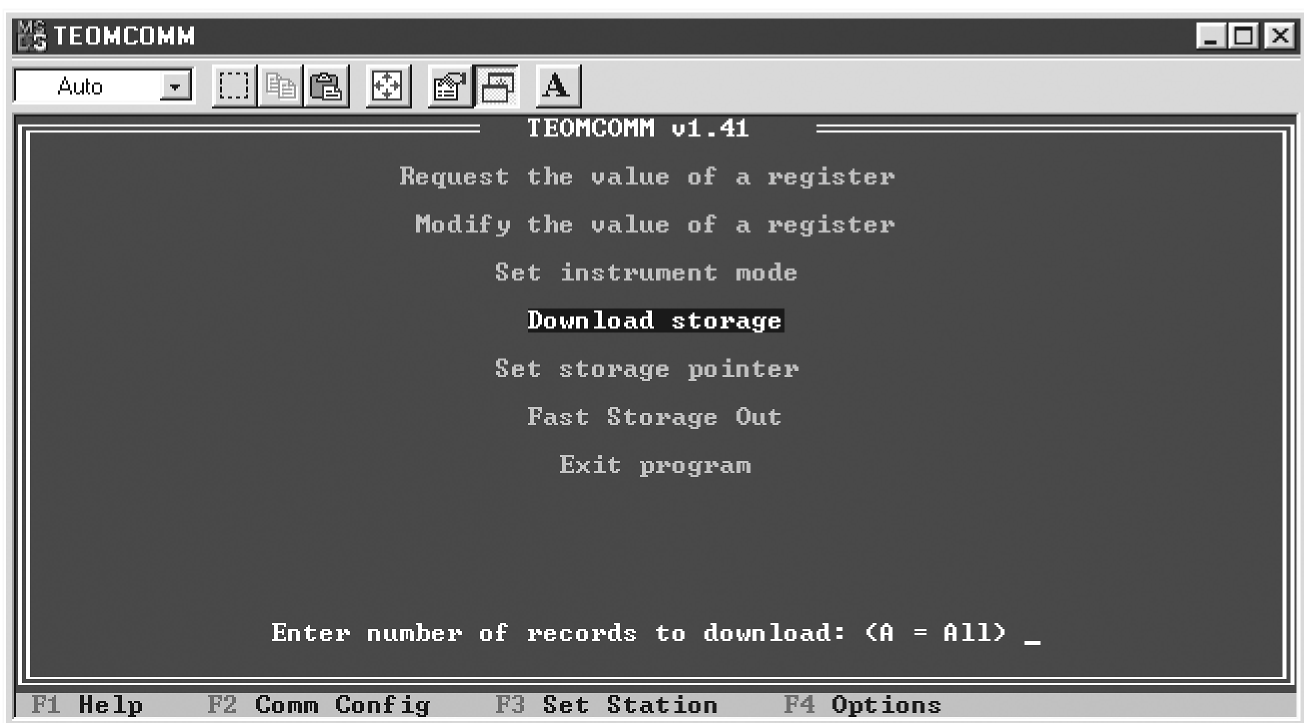
The user may choose between the following Operating Modes:

Operating Mode 1	This selection puts the monitor into the Run Mode (Section 6)
Operating Mode 2	This selection puts the instrument into the Setup Mode (Section 6).
Operating Mode 3	This selection puts the instrument into the Stop Mode (Section 6).
Operating Mode 4	This selection toggles the Analog Output 1 field between its normal operating mode and its use as a Status Watch indicator (Section 4).
Operating Mode 5	This selection allows the user to exercise the SFxx command (Set Function xx) defined in the AK Protocol (Appendix C). For example, the user can set the monitor's time parameter by using command code "26" while in Operating Mode 5 (Appendix C).

J.3.4. Download Storage

This command allows the user to download data records that are stored in the monitor's internal data buffer. The data download will begin at the current location of the storage pointer and end at the most recently recorded data record. When the user selects this command, the PC will request the number of data records that they want to download (Figure J-8).

Figure J-8. TEOMCOMM Main screen with request for number of data records to be downloaded displayed.

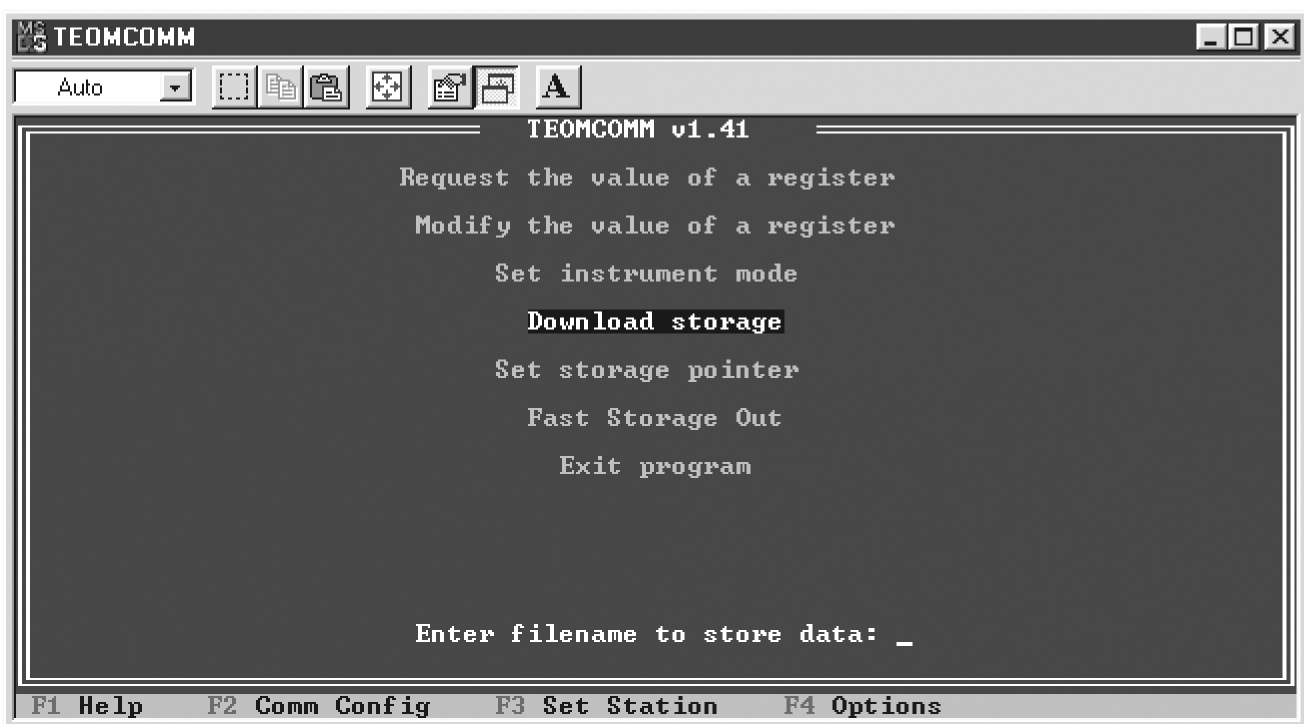


If the user wants to download all available data records from the current position of the storage pointer to the end of the storage buffer, the user should enter an “A.” If the user wants to download a specific number of records starting at the storage pointer, they should enter a specific number. If the number that the user enters is greater than the number of data records that are present between the current storage pointer location and the end of the data buffer, the PC will download all data records from the current position of the storage pointer to the end of the storage buffer.

✔ Set the storage pointer to the desired location before executing the Download Storage command.

After the user enters an “A” or a specific number, the computer will request a filename which the TEOMCOMM software program will use to save the data (Figure J-9).

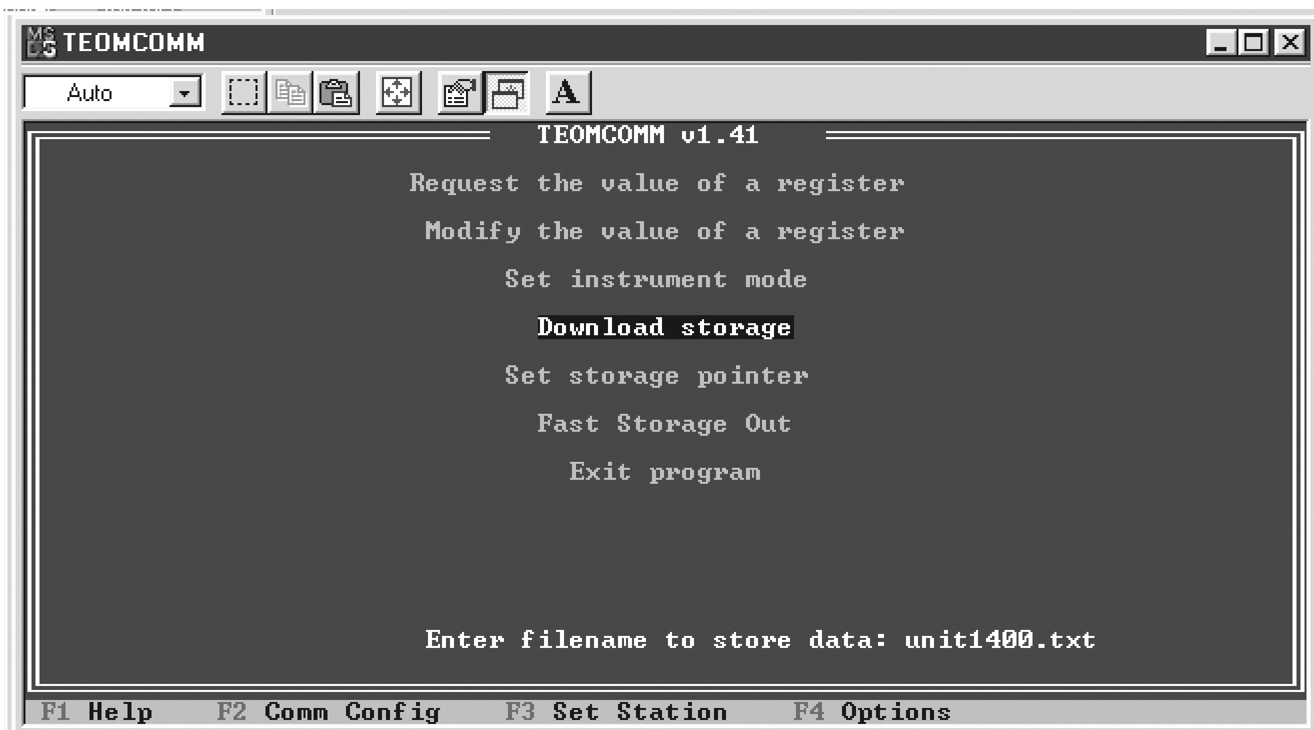
Figure J-9. TEOMCOMM Main screen with request for file name to store data displayed.



The user must enter an MS-DOS compliant file name to save the data file name (Figure J-10). An MS-DOS compliant file name is an 8-character file name, a period or dot ("."), and then a 3-character file extension (such as, "txt"). For example, "site256.txt" would be an acceptable file name. When the user enters an MS-DOS compliant file name, the PC will download the appropriate number of records and save them on its hard drive. Also, the PC will display a confirmation message that will show the number of data records that were saved to the appropriate file name.

✔ The location of the storage pointer may be changed remotely.

Figure J-10. TEOMCOMM Main screen with data file name entered.



NOTE: After TEOMCOMM downloads the data records, it will position the storage pointer after the last data record that was transmitted. This will ensure that the previously transmitted data records will not be transmitted again at the next data download. If the user wishes to transmit the data records a second time, they must change the position of the storage pointer by using the Set Storage Pointer command (Section J.3.5.).

J.3.5. Set Storage Pointer

This command allows the user to change the location of the storage pointer in the monitor's internal data storage buffer. When the user selects this command, PC will display the current location of the storage pointer and request the new storage pointer position.

✔ Set the storage pointer to the desired location before executing the Download Storage command.

The user may enter the following values to move the storage pointer's position:

B — This value will move the storage pointer to the beginning of the data storage buffer. The beginning of the data storage buffer contains the oldest record in the buffer.

E — This value will move the storage pointer to the end of the data storage buffer. The end of the data storage buffer contains the most recent data record that was recorded.

✔ The location of the storage pointer may be changed remotely.

Positive number — The entry of a positive number causes the storage pointer to move from its current position forward through the data records by the number entered. This command moves the storage pointer toward the end of the data storage buffer (i.e., toward the newest data record that was recorded).

Negative number — The entry of a negative number causes the storage pointer to move from its current position backward through the data records by the number entered. This command moves the storage pointer toward the beginning of the data storage buffer (i.e., toward the oldest record in the buffer).

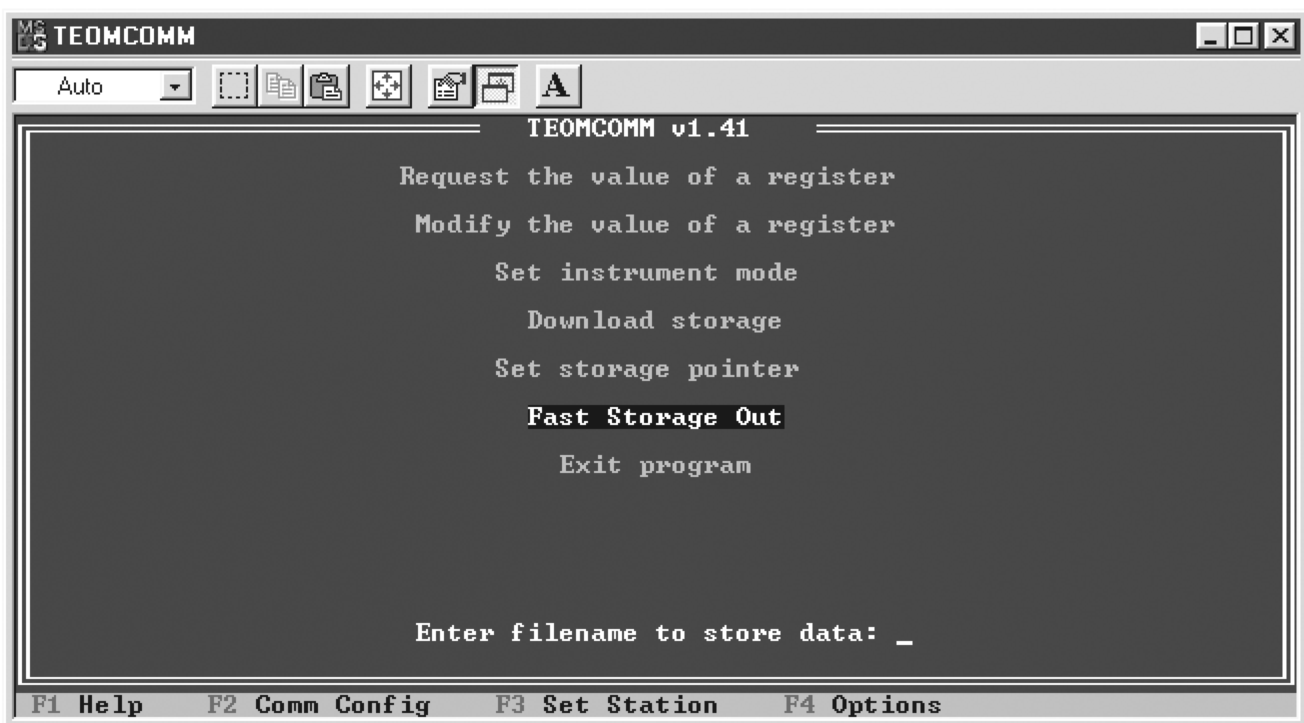
After the user entered a value, the PC will display the contents of the data record at the new location of the storage pointer.

J.3.6. Fast Storage Out

This command allows the user to download records stored in the data storage buffer using the "Fast Store Out" RS232 Mode (Section 9). This command can be used only when the PC is connected directly to the monitor. It can not be used when the PC is connected to a modem.

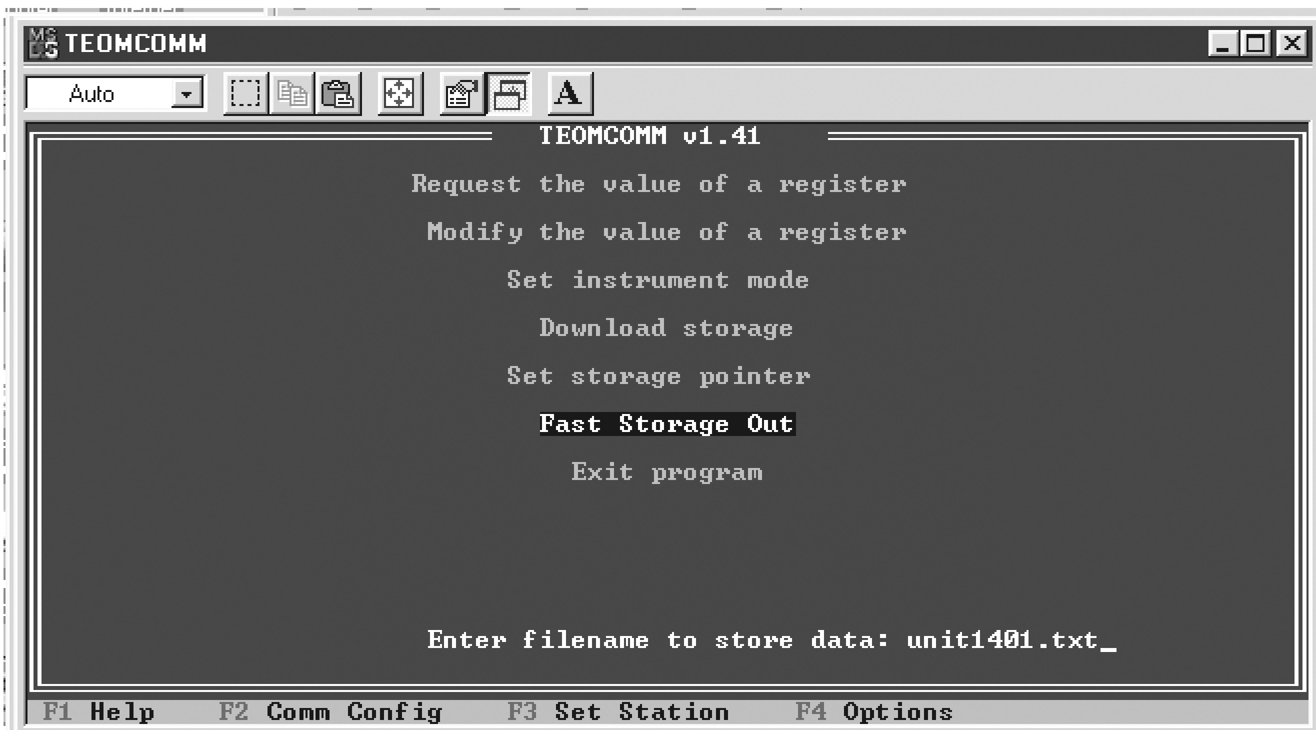
The Fast Storage Out command is similar to the Download Storage command. The Fast Storage Out command allows the user to download data records that are stored in the monitor's internal data buffer. The data download will begin at the current location of the storage pointer and end at the most recently recorded data record. When the user selects this command, the computer will request a filename which the TEOMCOMM software program will use to save the data (Figure J-11).

Figure J-11. TEOMCOMM Main screen with request for file name to store data displayed.



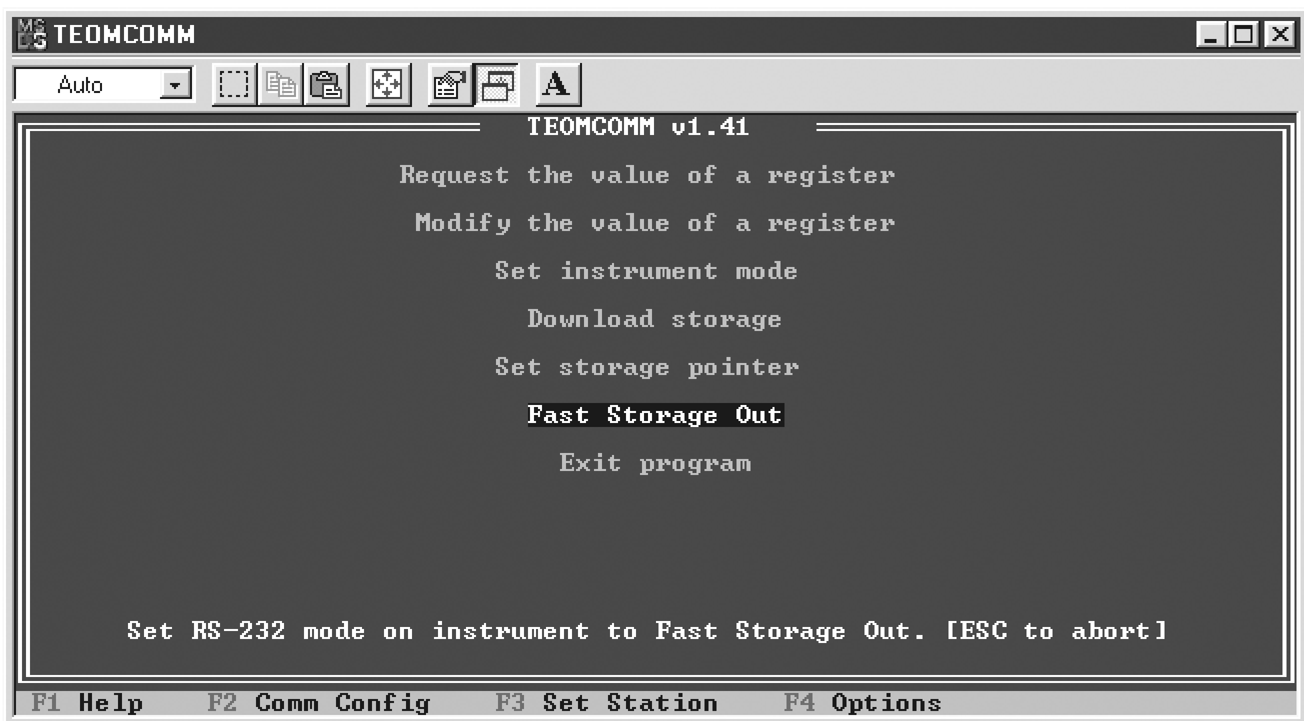
The user must enter an MS-DOS compliant file name to save the data file name (Figure J-12).

Figure J-12. TEOMCOMM Main screen with data file name entered.



An MS-DOS compliant file name is an 8-character file name, a period or dot ("."), and then a 3-character file extension (such as, "txt"). For example, "site256.txt" would be an acceptable file name. When the user enters an MS-DOS compliant file name, the computer will request that the user change the monitor's RS232 Mode to "Fast Storage Out" (Figure J-13).

Figure J-13. TEOMCOMM Main screen with request to change monitor's RS232 mode to Fast Store Out displayed.



When the user changes the monitor's RS232 Mode to "Fast Storage Out," the PC will download the appropriate number of records and save them on its hard drive. Also, the PC will display a confirmation message that will show the number of data records that were saved to the appropriate file name.

NOTE: After TEOMCOMM downloads the data records, user should immediately change the monitor's RS232 Mode to "None" or "AK Protocol."

J.3.7. Exit Program

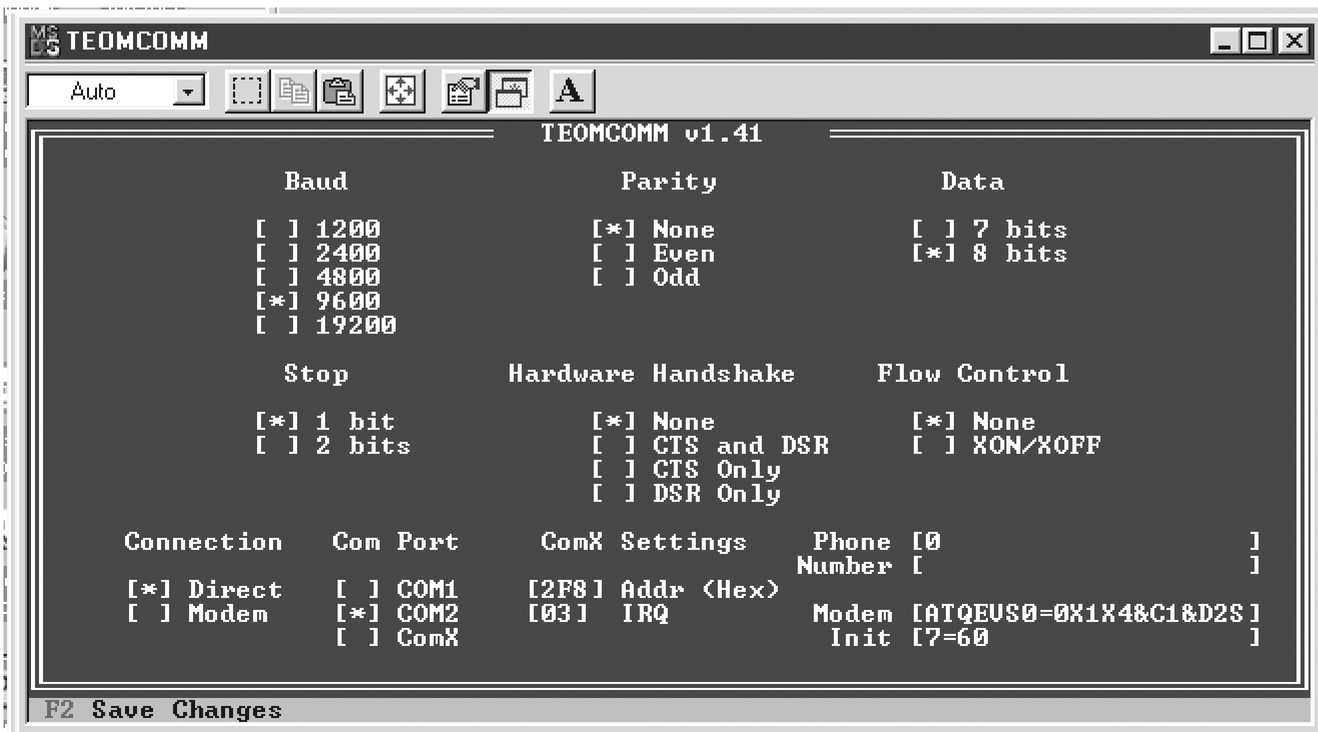
✔ The TEOMCOMM program disconnects any existing communication links when the user exits the program.

This command stops the TEOMCOMM software program from running and returns the PC to an MS-DOS prompt. If the user established modem communication when running TEOMCOMM, the modem connection will be automatically disconnected when the user selects the Exit Program command.

J.4. TEOMCOMM Communications Setup Screen

The user can change the communication parameters of the TEOMCOMM software program when in the TEOMCOMM Communications Setup screen (Figure J-14). When in the TEOMCOMM Main screen (Figure J-1), press F2 to display the TEOMCOMM Communications Setup screen.

Figure J-14. TEOMCOMM Communications Setup screen.



The TEOMCOMM Communications Setup screen contains the following information:

Baud Rate — This field contains the data transmission rate (baud), which may be set to 1200, 2400, 4800, 9600, or 19200 baud. The default setting for the monitor is "9600." Refer to the Service Manual if you suspect that the monitor's baud rate has been changed. If you want to connect the monitor to a PC through a modem, the Baud Rate value must be set to the lowest of the following three values: (1) the maximum baud rate of the modem used with the instrument, (2) the maximum baud rate of the modem used with the computer, or (3) the baud rate setting of the instrument (default = 9600). The maximum baud rate supported by the TEOMCOMM software is 19200.

Parity — This field contains the parity of data transmission, which can be defined to be either "None," "Even," or "Odd." The default setting for the monitor is "None." Refer to the Service Manual to change the monitor's parity setting.

Data — This field contains the word length (data bits), which may be either 7 or 8 bits. The default setting for the monitor is "8." Refer to the Service Manual to change the monitor's data bits setting.

Stop — This field contains the number of stop bits for each character transmitted, which may be either 1 or 2. The default setting for the monitor is "1." Refer to the Service Manual to change the monitor's stop bits setting.

Hardware Handshake — This field contains the monitor's hardware handshaking, which manages the flow control of data at the hardware level. The default setting for the monitor is "None." Refer to the Service Manual to change the monitor's hardware handshake setting.

Flow Control — This field contains the type of communication flow control, which may be either "None" or "Xon/Xoff." The default setting for the monitor is "None." Refer to the Service Manual to change the monitor's flow control setting.

Connection	This field contains the monitor's communication mode: Direct or Modem). The Direct Mode is used to connect the instrument directly to an on-site computer. The Modem Mode is used to connect the instrument to a remote computer using a modem.
Communication Port	This field contains the PC's communication (COM) port that the control unit is connected to (Direct Mode), or that the modem is connected to (Modem Mode). The range for this paramater is 1, 2, 3, or 4.
ComX Settings	This field contains the settings for the PC's communication (COM) port that the control unit is connected to (Direct Mode), or that the modem is connected to (Modem Mode).
Phone Number	This field contains the phone number that the modem will dial to establish a connection with the off-site computer.
Modem Init	This field contains the modem's initialization settings.

J.5. Sending Header and Trailer Codes

The TEOMCOMM Send String screen (Figure J-15) allows the user to send a string of characters through the personal computer's (PC's) RS232 port. The user may define and send both a header and trailer string when in this screen. Press F4 to display the TEOMCOMM Send String screen.

Figure J-15. TEOMCOMM Send String screen.

J.6. Instrument Setup for Direct Communication

Your PC must be connected to the monitor's control unit.

Follow these steps to connect the PC to the monitor:

1) **Connect one end of the 9-to-9 pin computer cable to one of the RS232 ports on the control unit.**
2) **Ensure that nothing is connected to the other RS232 port of the control unit.**
3) **If your PC is equipped with a 9-pin RS232 connector, go to step 4. If your personal computer is equipped with a 25-pin connector, go to step 5.**
4) **Plug the other end of the 9-to-9 pin computer cable into the 9-pin RS232 port of your PC. Go to step 8.**
5) **Locate the 9-to-25 pin computer cable adapter.**
6) **Plug the 9-to-25 pin computer cable adapter into the 25-pin port on your PC.**
7) **Plug the other end of the 9-to-9 pin computer cable into the 9-to-25 pin computer cable adapter. Go to step 8.**

   NOTE: Do not use the 9-to-25 pin modem cable to connect the control unit with the PC. The 9-to-25 pin modem cable is configured for use only with a modem.

✔ Set the instrument to the AK Protocol when operating the TEOMCOMM software.

8) **Press <RS232> on the monitor's keypad to display the Set RS-232 Mode screen (Figure J-16).**

Figure J-16. Set RS-232 Mode screen.

```
      SET RS-232 MODE
  Mode: AK Protocol
 >AK Protocol
  German Prot
```

9) **When in the Set RS-232 Mode screen, press the "EDIT" key.**
10) **Press the up and down arrow keys to select "AK Protocol," and then press ENTER.**

   NOTE: When using the TEOMCOMM software to operate the instrument, set the RS232 protocol to "AK Protocol" to perform all of the commands on the TEOMCOMM Main screen (Figure J-1). However, if you want to download data

with TEOMCOMM using the “Fast Storage Out” RS232 Mode (Sections 9 and J.3.6), set the RS232 protocol to “Fast Store Out.”

Figure J-17. Com 2-Way Settings screen.

```
      COM 2-WAY SETTINGS
RS-Para 1 >              52
RS-Para 2             75048
RS-Para 3             13010
```

11) Press <0> and <7>, and then press <ENTER> to display the Com 2-Way Settings screen (Figure J-17).

12) When in the Com 2-Way Settings screen, enter the following parameters in these fields:

RS-Para 1	52
RS-Para 2	75048
RS-Para 3	13010
RS-Para 4	0

13) Press <ENTER>.

Figure J-18. FDMS Series 8500 Main screen.

```
OK    4+  21%  NU    09:39
Mass Conc             11.5
01-Hr MC              12.5
08-Hr MC               8.3
```

14) Press <ESC> to display the Series 8500 Main screen (Figure J-18).

15) Ensure that the PC is communicating with the monitor through TEOMCOMM by selecting one of the commands from the TEOMCOMM Main screen (Section J.3).

Appendix K: Outdoor Enclosure

The Outdoor Enclosure provides a heated and air-conditioned environment for the Series 1400a control unit, Series 1400a sensor unit and pump of the Series 8500 FDMS Monitor. It also contains enough space in its 19-inch mounting rack for the installation of data-logging equipment.

The outdoor enclosure comes in Revision A and Revision B models. The Revision B model has a pre-cut hole in the top of the enclosure to accommodate the 8500 module enclosure. For Revision A models, the user must modify the top of the enclosure to accommodate the installation of the 8500 module (Section K.2). This appendix describes the installation and maintenance of the outdoor enclosure.

Figure K-1. Outdoor enclosure.

K.1. Compilation Package

You must use the 8500 Roof Modification package (59-009115) to install the 8500 module into a Revision A outdoor enclosure or a Revision B outdoor enclosure. The kit includes:

8500 module enclosure
2 14 1/2-inch x 13-inch 8500 module enclosure gaskets
8500 module enclosure cover
Support arm
2 8500 module enclosure gaskets
Sensor unit spacer
14-inch inlet tube
Flow splitter extension
3 m 3/8-inch green nylon tubing
Black plastic duct hood
4 3/4-inch, #6 self tapping screws
18 inches (46 cm) of 4-inch black, plastic flexible tubing with two hose clamps
Circulating fan kit
Pump kit
1/2-inch metal push-to-connect union fitting
3/8-inch plastic push-to-connect union fitting
8 1/4-20 x 1 1/2-inch pan-head screws
8 1/4-inch flat washers
4 #10-32 x 3/4-inch pan-head screws
4 #10 flat sealing washers
Nylon ferrules

NOTE: The 8500 Roof Modification Kit includes nylon ferrules that may be used in place of the metal ferrules that are installed inside the Swagelok fittings. Using the nylon ferrules in place of the metal ferrules allows the user to create temporary connections rather than permanent connections.

NOTE: Refer to Section 2 for instructions on installing the water condensation trap kit into the enclosure.

If you have a Revision A outdoor enclosure (no pre-cut 14-inch by 13-inch hole in the top of the enclosure), go to Section K.2 (Preparing a Revision A Enclosure). If you have a Revision B Enclosure, go to Section K.3 (Pump Installation).

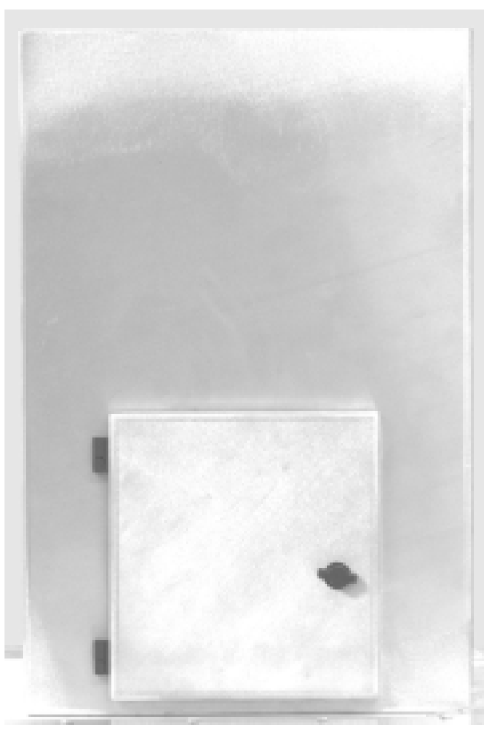
K.2. Preparing a Revision A Outdoor Enclosure

Revision A enclosures must be modified before installing the Series 8500 FDMS Monitor.

Follow these steps to prepare the enclosure:

1) **Locate the outdoor enclosure (Figure K-1).**
2) **If you are retrofitting an existing Series 1400a complete outdoor enclosure to include the 8500 module, go to step 3. If you are setting up the outdoor enclosure for the first time (not retrofitting an existing Series 1400a system), go to step 6.**
3) **Turn off the Series 1400a control unit.**
4) **Remove the entire sample inlet system, including the size selective sample inlet, flow splitter and sample tube extension(s), seal plate, and where applicable, the ACCU System from the top of the enclosure.**
5) **Remove the Series 1400a sensor unit and control unit from the complete outdoor enclosure.**
6) **Locate the 8500 module enclosure (Figure K-2).**

Figure K-2. 8500 module enclosure.



7) Place the 8500 module enclosure on top of the outdoor enclosure (Figure K-3).

Figure K-3. 8500 module enclosure on top of the outdoor enclosure.

8) Ensure that the right-hand edge of the 8500 module enclosure fits against the right-hand edge of the metal seam on the top of the outdoor enclosure (Figure K-4).

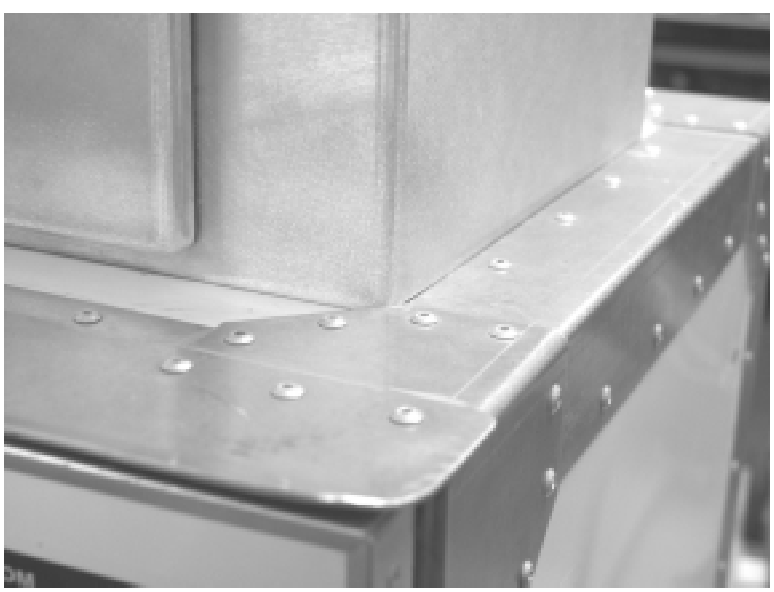
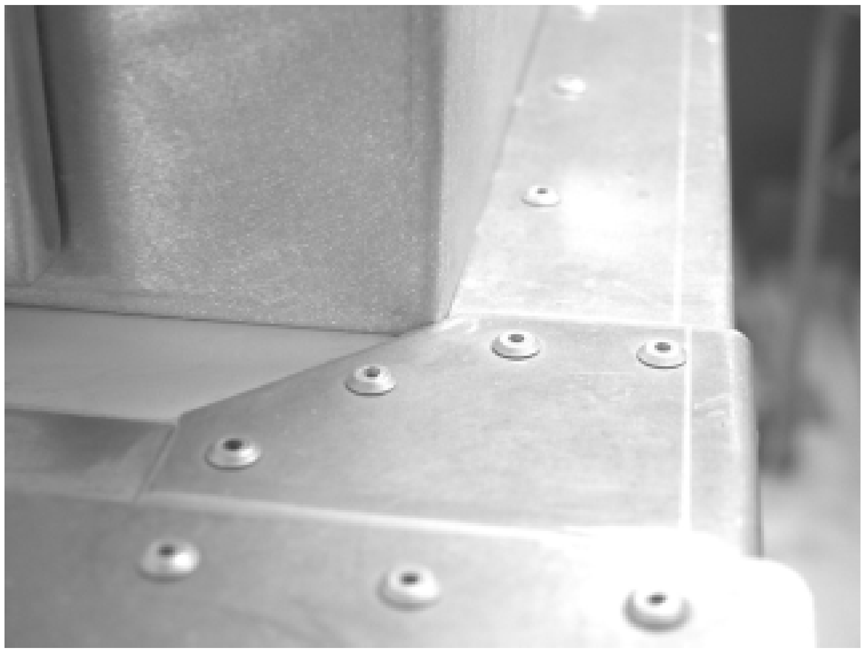


Figure K-4. 8500 module enclosure resting against the right-hand edge of the metal seam on the top of the outdoor enclosure.

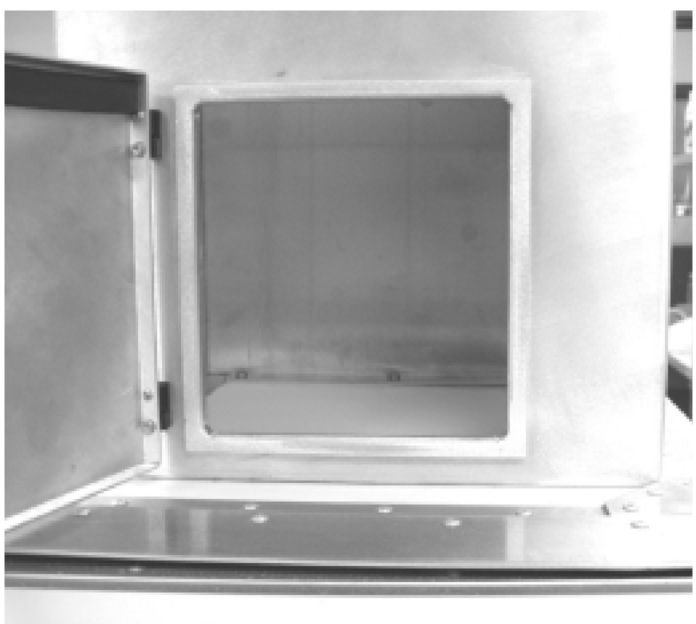
9) Ensure that the front, right-hand corner of the 8500 module enclosure fits into the front, right-hand corner of the metal seam on the top of the outdoor enclosure (Figure K-5).

Figure K-5. Close-up view of the front, right-hand corner of the 8500 module enclosure.



10) Open the door of the 8500 module enclosure (Figure K-6).

Figure K-6. 8500 module enclosure with door opened.



11) Use a pen or felt-tipped marker to outline the inside perimeter of the 8500 module enclosure (Figure K-7).

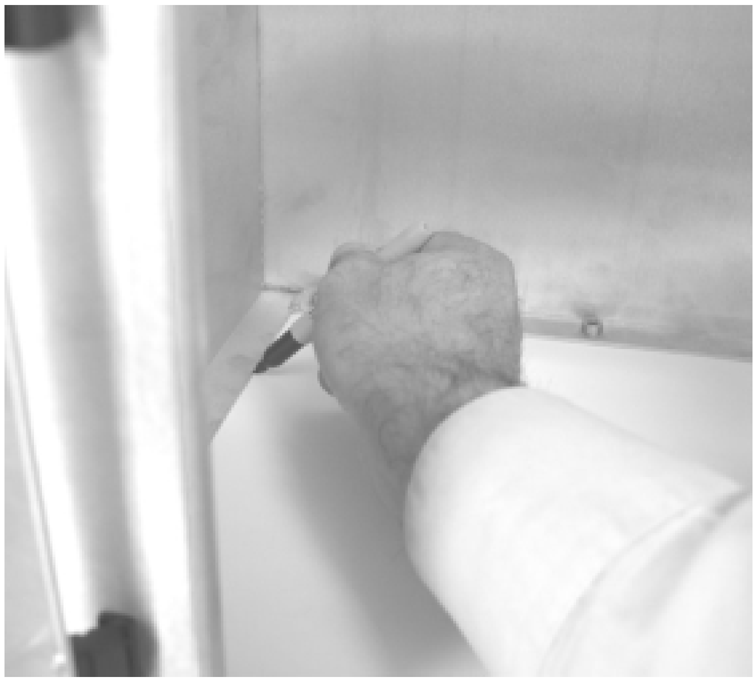


Figure K-7. Outlining the inside perimeter of the 8500 module enclosure.

12) Use a pen or felt-tipped marker to mark the eight screw holes located in the four sides of the enclosure (Figure K-8).

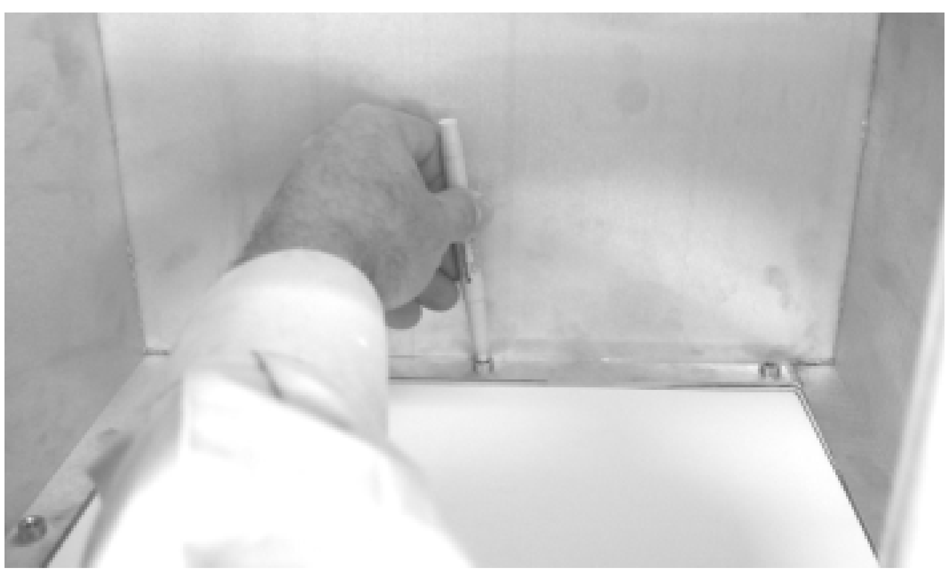
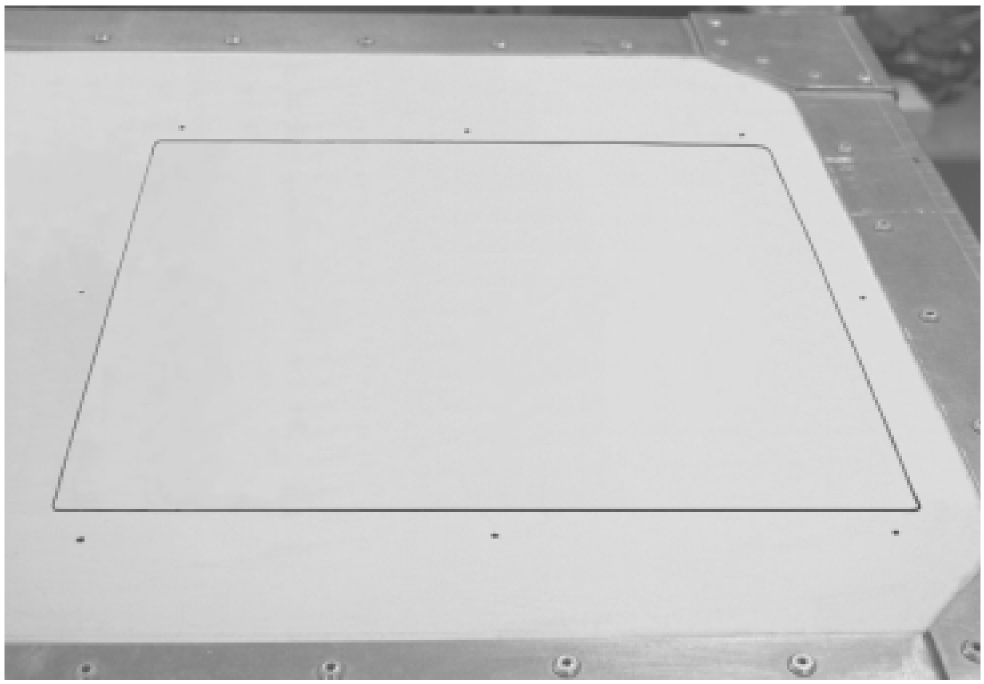


Figure K-8. Marking the eight screw holes on the bottom of the 8500 module enclosure.

13) Remove the 8500 module enclosure from the top of the outdoor enclosure (Figure K-9).

Figure K-9. Top of outdoor enclosure with 8500 module enclosure and screw-hole markings.



14) Using a 5/16-inch diameter bit, drill the eight new mounting holes in the screw-hole marks that you made in step 12 (Figure K-10).

Figure K-10. Drilling one of the new mounting holes.

15) Using a jigsaw, cut out the square section that you outlined in step 11 (Figures K-11, K-12 and K-13).

Figure K-11. Cutting out the square section.

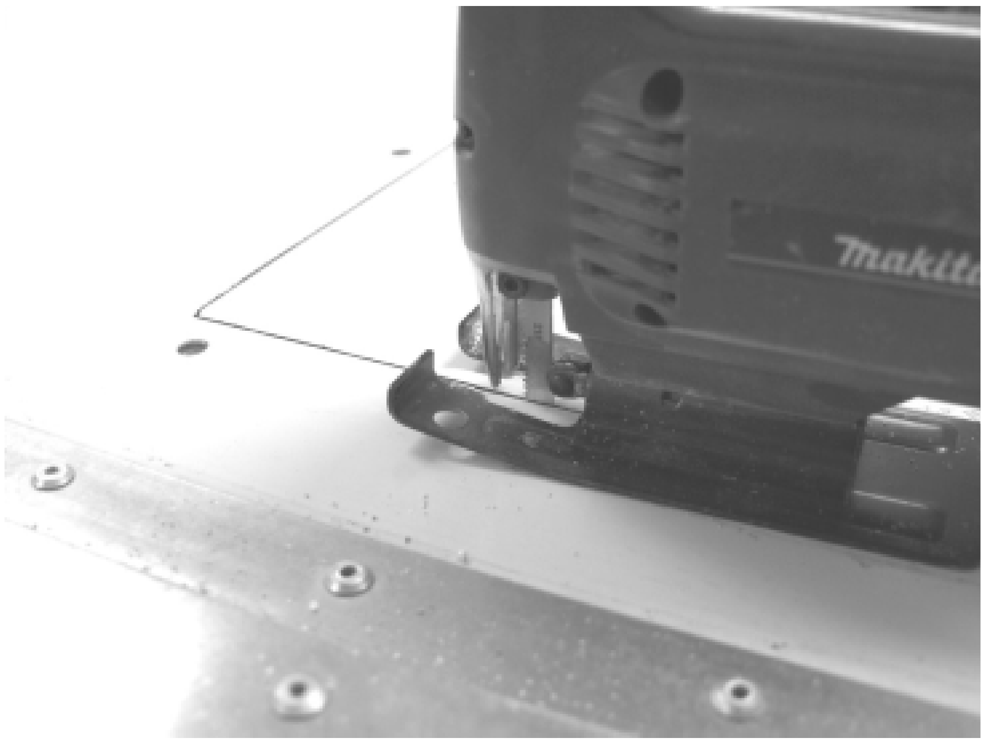
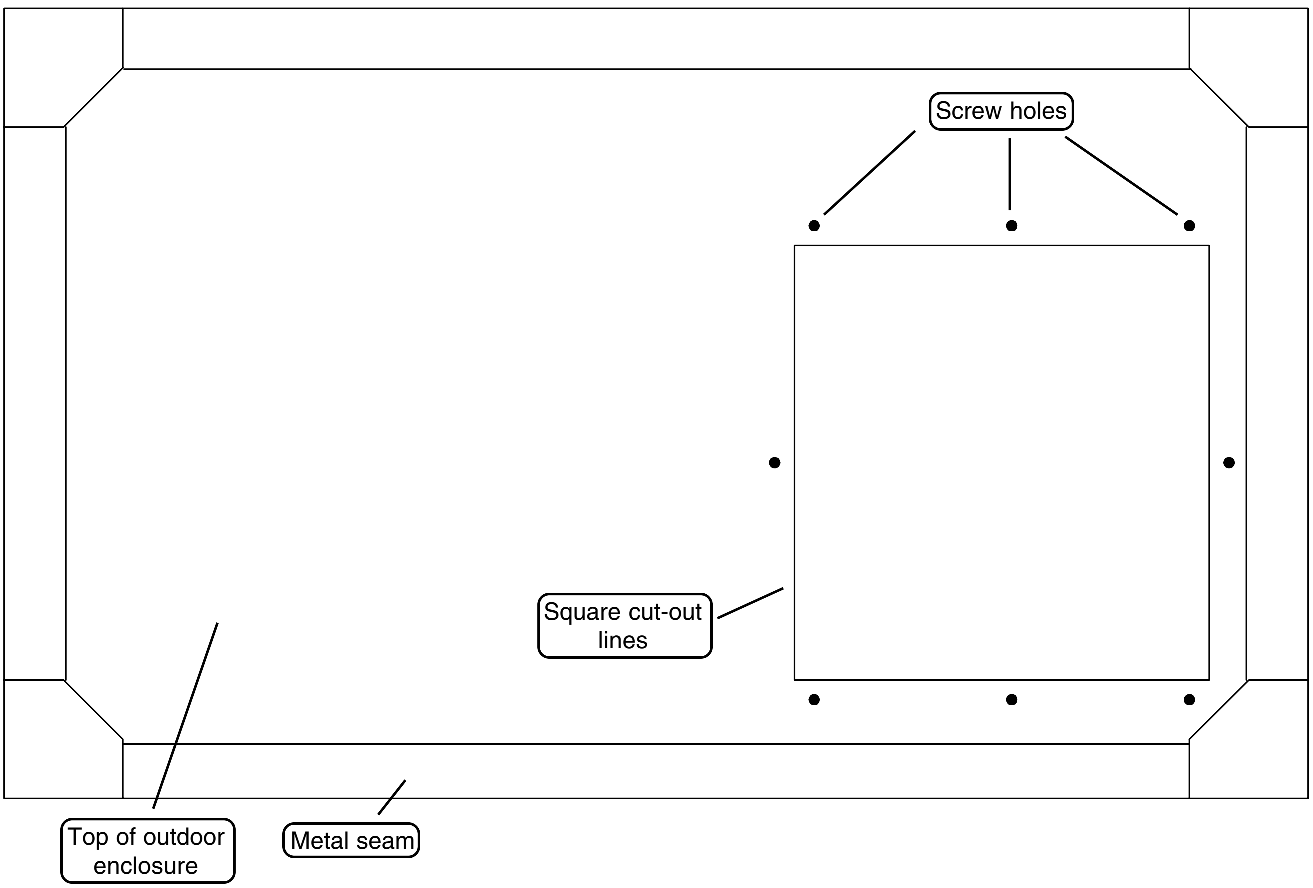


Figure K-12. Drawing of the top of the outdoor enclosure with the square cut-out lines.



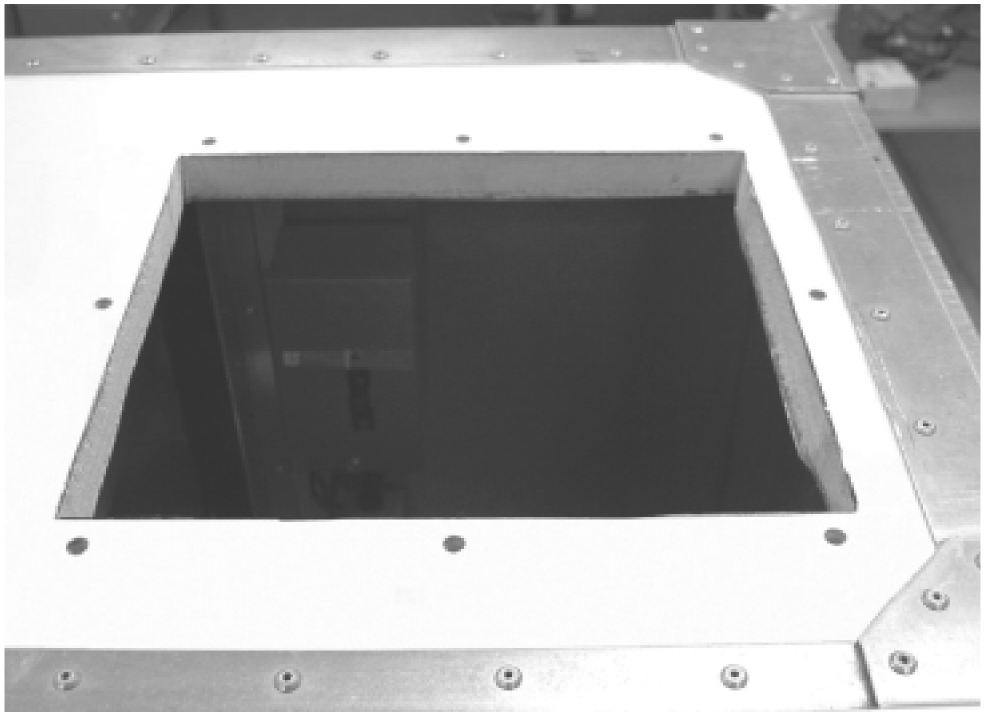


Figure K-13. Square section cut out of the top of the outdoor enclosure.

16) **Open the door of the outdoor enclosure.**

17) **Remove the debris and dust from the inside of the outdoor enclosure.**

18) **Go to Section K.3 (Installing the Black Plastic Tubing).**

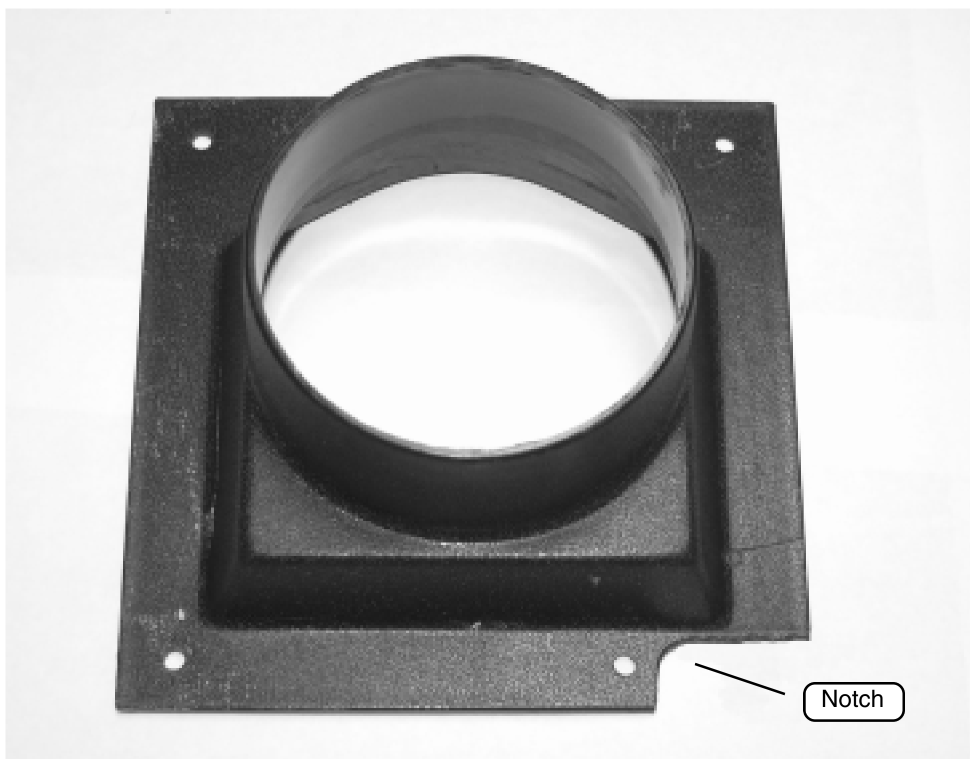
K.3 Installing the Black Plastic Tubing

You must install the 4-inch black plastic tubing into all Revision A enclosures and some Revision B enclosures. If your enclosure already has 4-inch black, plastic tubing installed in the center of the enclosure, go to Section K.4 (Pump Installation).

Follow these steps to install the black plastic tubing:

1) Locate the black plastic duct hood (Figure K-14).

Figure K-14. Black plastic duct hood.



2) Remove any equipment, tubing or other materials from the area in front of the air-conditioning cool-air inlet (Figure K-15).

Figure K-15. Inside view of outdoor enclosure with the cool-air inlet and diverter highlighted.

3) Remove the diverter from the cool air inlet (Figure K-15).

NOTE: You may need to drill out the rivets to remove the diverter.

4) Place the duct hood over the enclosure's cool-air inlet, ensuring that the notch in the hood (Figure K-14) fits over the bolt at the bottom, right-hand corner of the cool-air inlet (Figures K-16 and K-17).

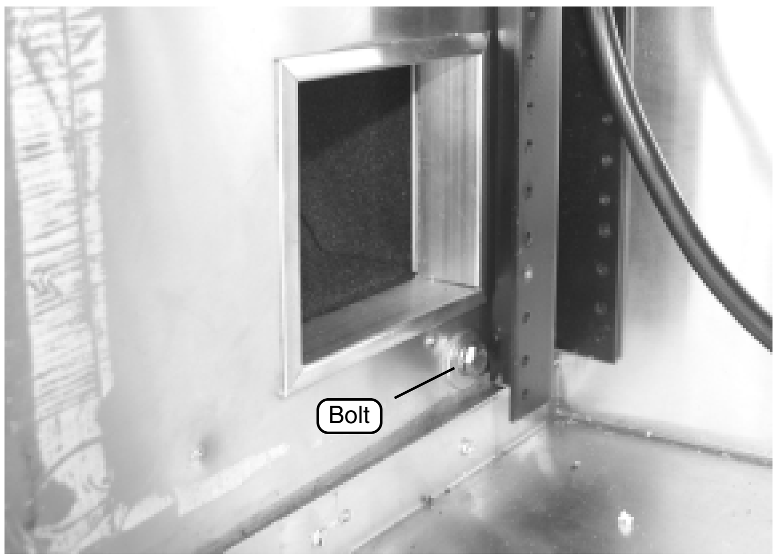


Figure K-16. Cool-air inlet with bolt highlighted.

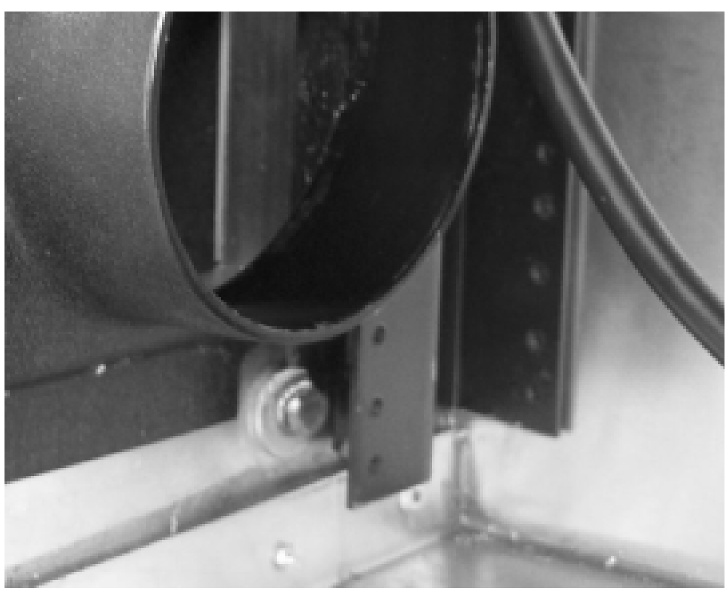
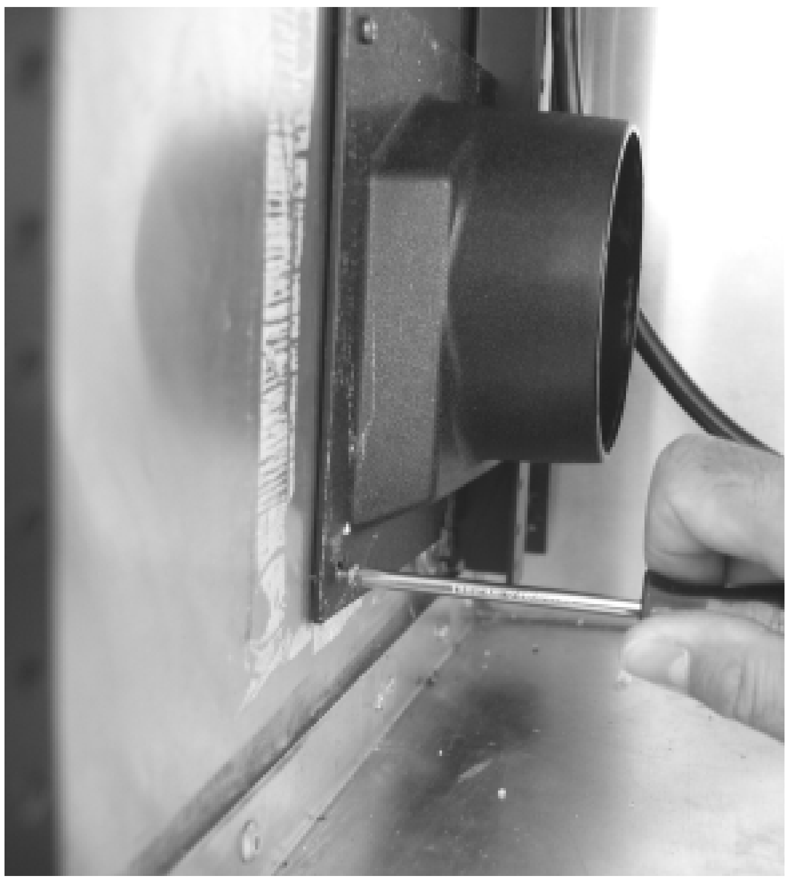


Figure K-17. Notch of hood mounted over the enclosure bolt.

5) Install one of the 3/8-inch, #6 self-tapping screws in one of the holes in the duct hood. Place your screwdriver into the screw and press firmly to start the screw threading into the enclosure wall (Figure K-18).

NOTE: You can hold the screwdriver in the screw and strike the top of the screwdriver with the palm of your hand to help start the screw.

Figure K-18. Installing the duct hood.



6) Tighten the screw.

7) Repeat steps 5 and 6 with the other screws.

8) Go to Section K.4 (Pump Installation).

K.4. PUMP INSTALLATION

The outdoor enclosure includes a pump kit containing the necessary hardware to install the pump. If you are setting up the outdoor enclosure for the first time (not retrofitting an existing Series 1400a system), be sure to follow the instructions in this section to install the pump into the outdoor enclosure. However, if you are retrofitting an existing Series 1400a complete outdoor enclosure to include the 8500 module, your outdoor enclosure will already have a pump installed. Go to Section K.4 (8500 Module Installation).

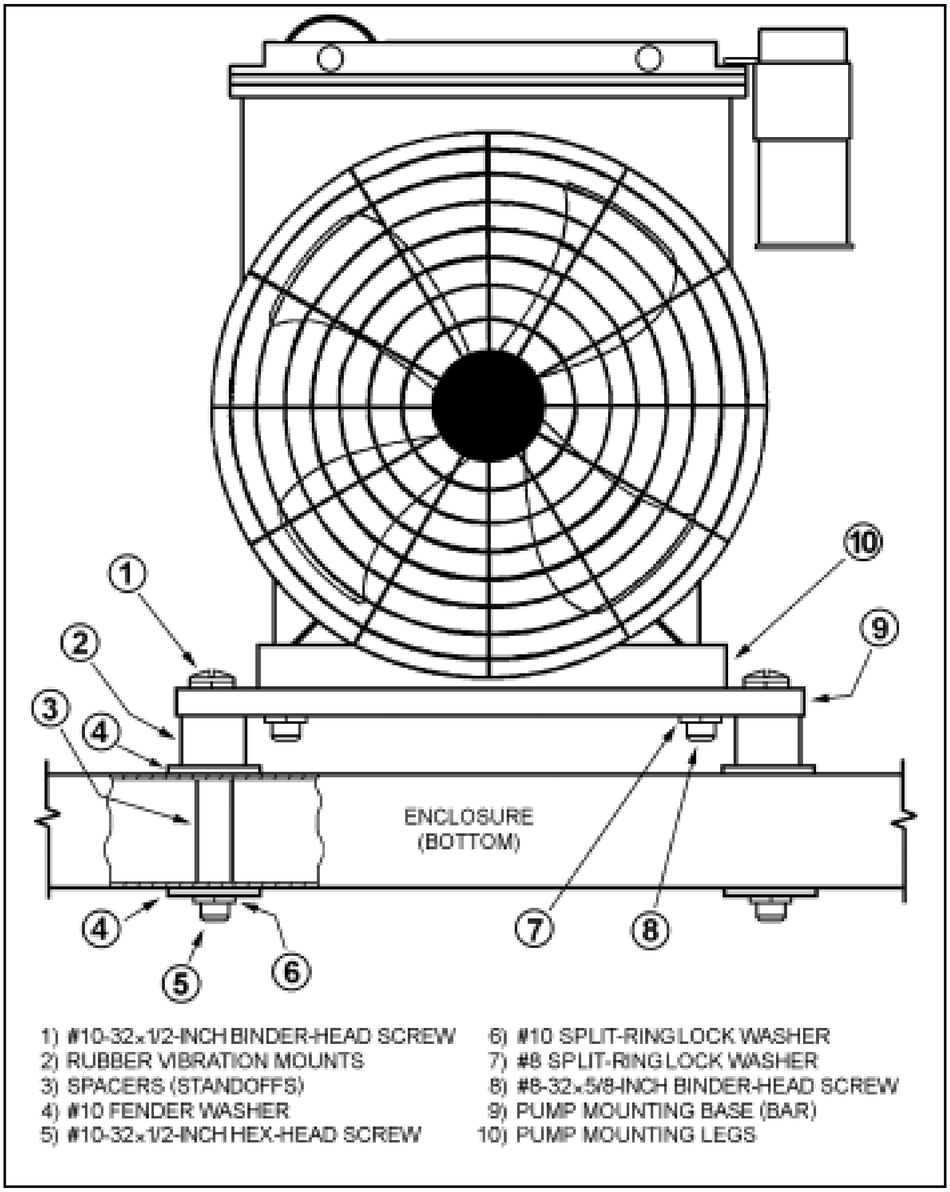
The pump kit includes:

- Pump
- Mounting base (bar)
- Black rubber cork (plug)
- 4 rubber vibration mounts
- 4 spacers (standoffs)
- 4 #8-32 x 5/8-inch, binder-head, slot screws (step 1)
- 4 #8 split-ring, lock washers (step 1)
- 8 #10 fender washers (steps 2 and 6)
- 4 10-32 x 1/2-inch, binder-head, slot screws (step 3)
- 8 #10 split-ring, lock washers (steps 3 and 6)
- 4 #10-32 x 1/2-inch, hex-head screws (step 6)

Follow these steps to install the pump in the outdoor enclosure:

1) **Attach the mounting base of the pump to the pump mounting legs (Figure K-19) using the four #8-32 x 5/8-inch, binder-head, slot screws and four #8 split-ring, lock washers.**

Figure K-19. Pump installation drawing.



2) Secure the four spacers onto the male end of the four rubber vibration mounts (Figure K-19). Be sure to insert a #10 fender washer (four washers total) between the spacers and the rubber vibration mounts.

3) Secure the vibration mount assemblies to the pump mounting legs using the four #10-32 x 1/2-inch, binder-head, slot screws and four #10 split-ring, lock washers (Figure K-19).

4) Insert the entire pump assembly into the enclosure's pump compartment, located on the bottom, left-hand side of the outdoor enclosure.

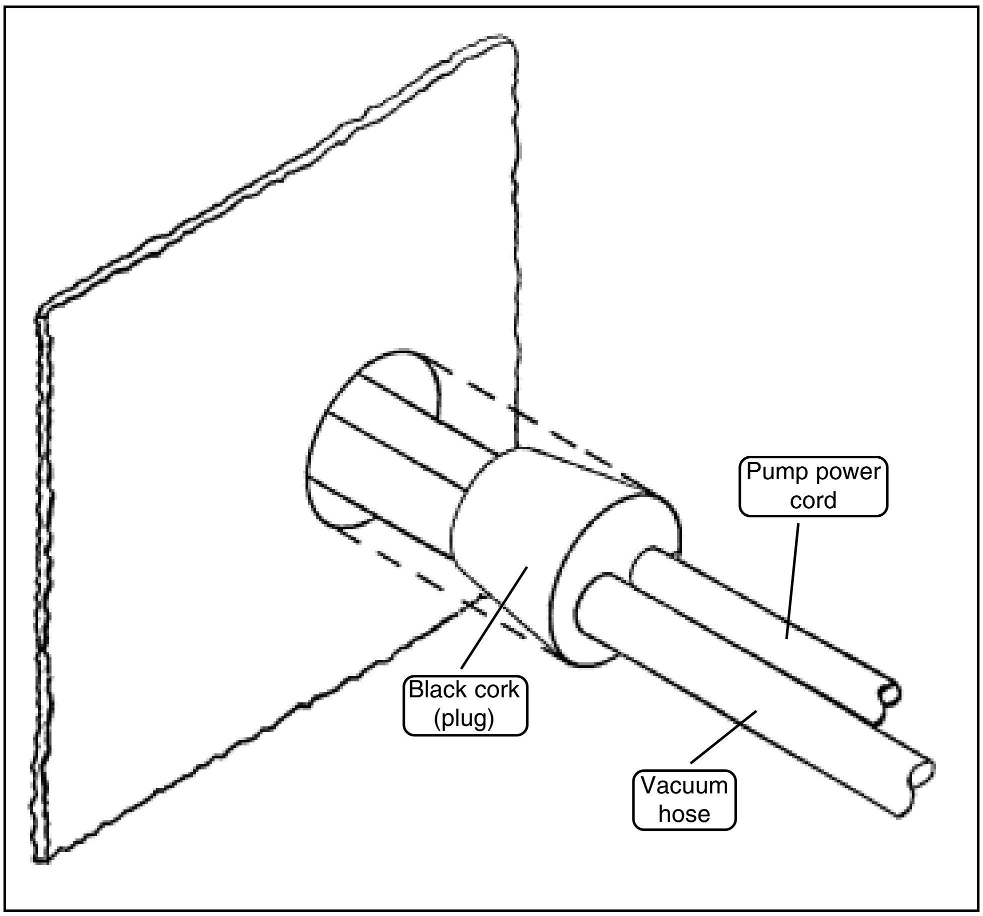
5) Ensure that the four spacers are in their proper positions.

6) Secure the pump assembly to the bottom of the enclosure with the four #10-32 x 1/2-inch, hex-head screws, four #10 split-ring, lock washers and four #10 fender washers (Figure K-19).

7) Place the power cord and vacuum tubing into the appropriate holes in the black rubber cork and close the cork around them (Figure K-20). Push the black cork into the access hole located between the pump compartment and the enclosure. Go to Section K.4 (8500 Module Installation).

NOTE: The access hole must be tightly sealed to allow the air conditioner to work properly.

Figure K-20. Black cork installation.



K.5. 8500 Module Installation

The Revision A 8500, Revision B 8500 and Revision C 8500 modules can be installed in the outdoor enclosure.

The Revision A 8500 module has both a main flow inlet and a bypass flow inlet on top of the module (Figure K-21).

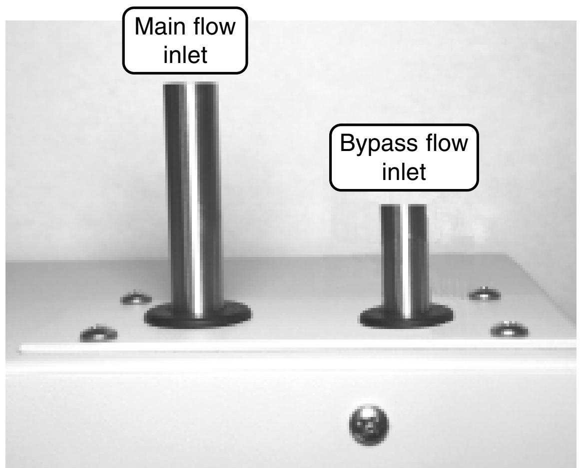


Figure K-21. Top of Revision A 8500 module with main flow inlet and bypass flow inlet.

The Revision B 8500 and Revision C 8500 modules have only the main flow inlet on the top of the module (Figure K-22). Also, the Revision B and revision C modules have an “FDMS System” label on the bottom, right-hand corner of the module (Figure K-23).

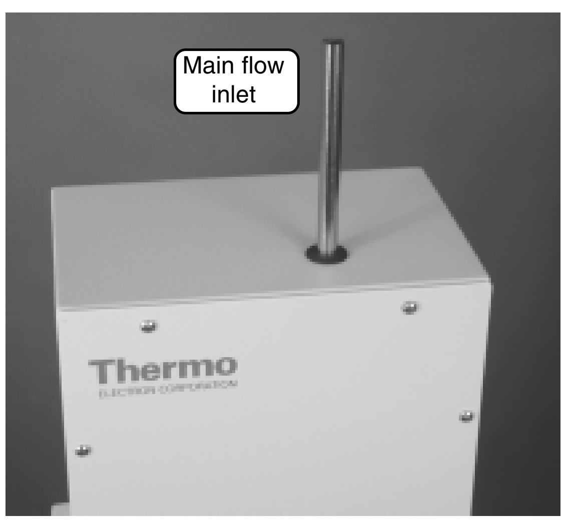


Figure K-22. Top of Revision B 8500 or Revision C 8500 module with main flow inlet.

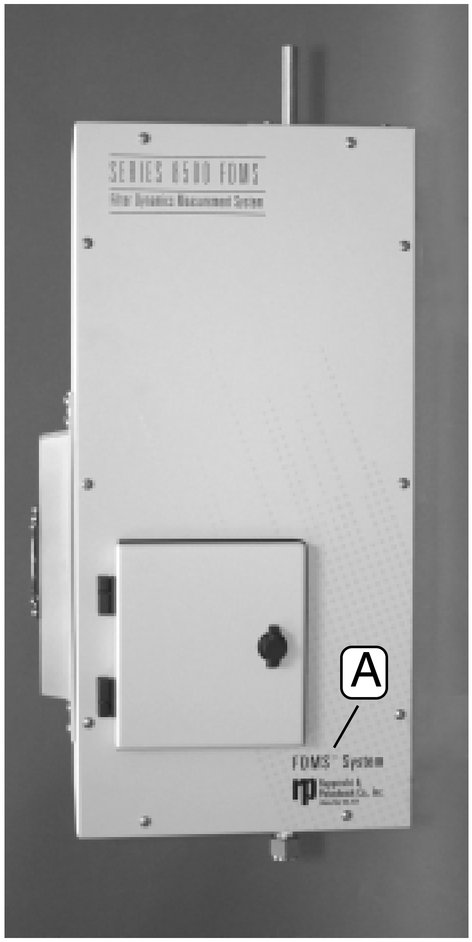


Figure K-23. Revision B 8500 module with “FDMS System” label (A) in bottom, right-hand corner.

Figure K-23A. Revision C 8500 module with “FDMS System.”

Refer to Section K.5.1 for instructions on installing a Revision A 8500 module. Refer to Section K.5.2 for installing a Revision B 8500 or a Revision C 8500 module.

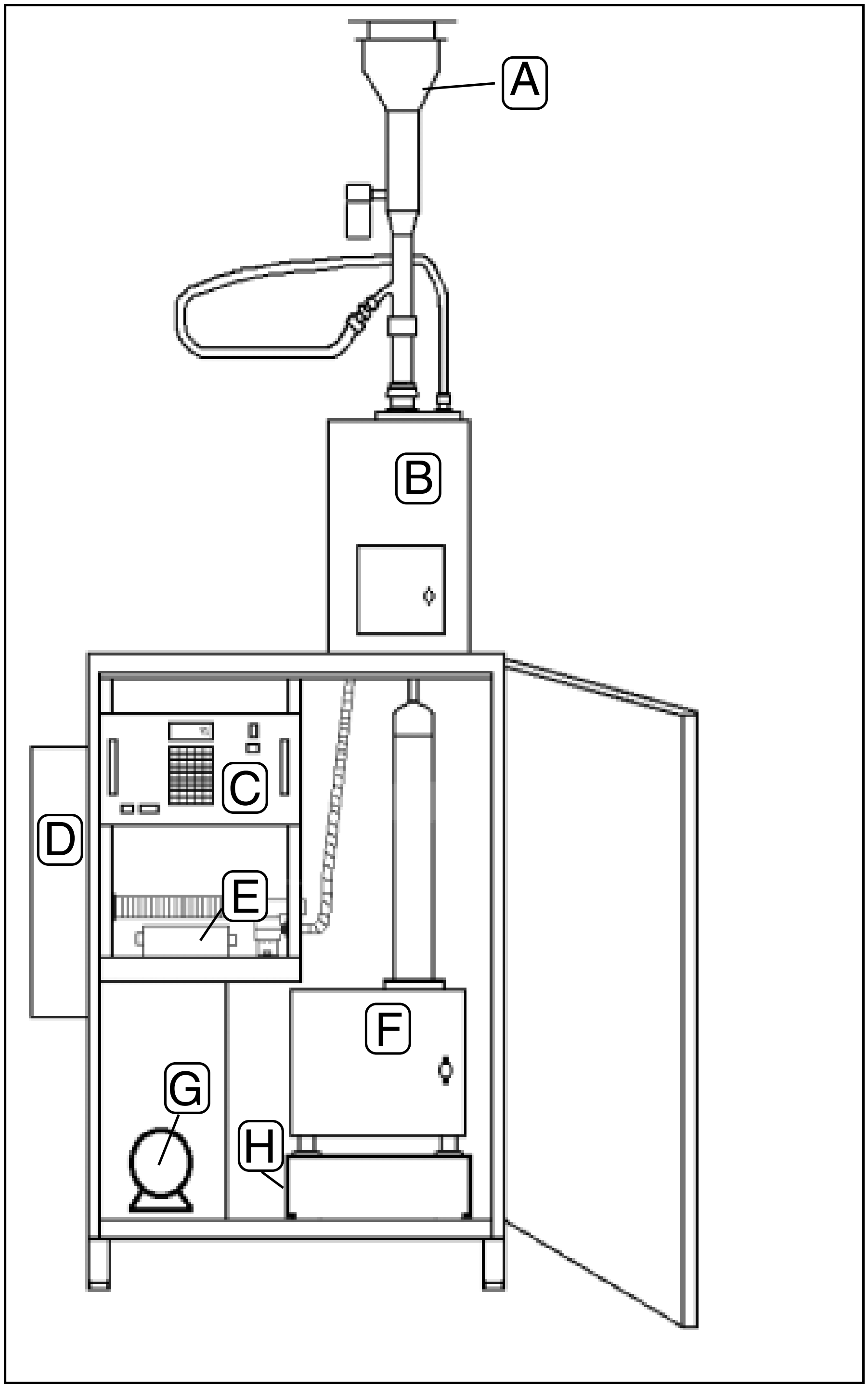
K.5.1. Installing a Revision A 8500 Module

You will need to refer to Section 2 of the Revision A, Series 8500 FDMS Filter Dynamics Measurement System Operating Manual for detailed instructions on installing electrical and flow connections.

Follow these steps to install a Revision A 8500 module into the outdoor enclosure:

1) Open the door of the outdoor enclosure (K-24).

Figure K-24. Instrument placement inside the outdoor enclosure:
A: Sample inlet
B: 8500 module enclosure
C: Control unit
D: Air conditioner
E: SES module
F: Sensor unit
G: Pump
H: Spacer.



2) Install the 8500 module brace onto the sensor unit (Section 2).

3) Locate the sensor unit spacer (Section K.2).

4) Place the spacer on the bottom, right-hand side of the outdoor enclosure (Figures K-25 and K-26).

5) Place the Series 1400a sensor unit on top of the spacer (Figures K-25 and K-26).

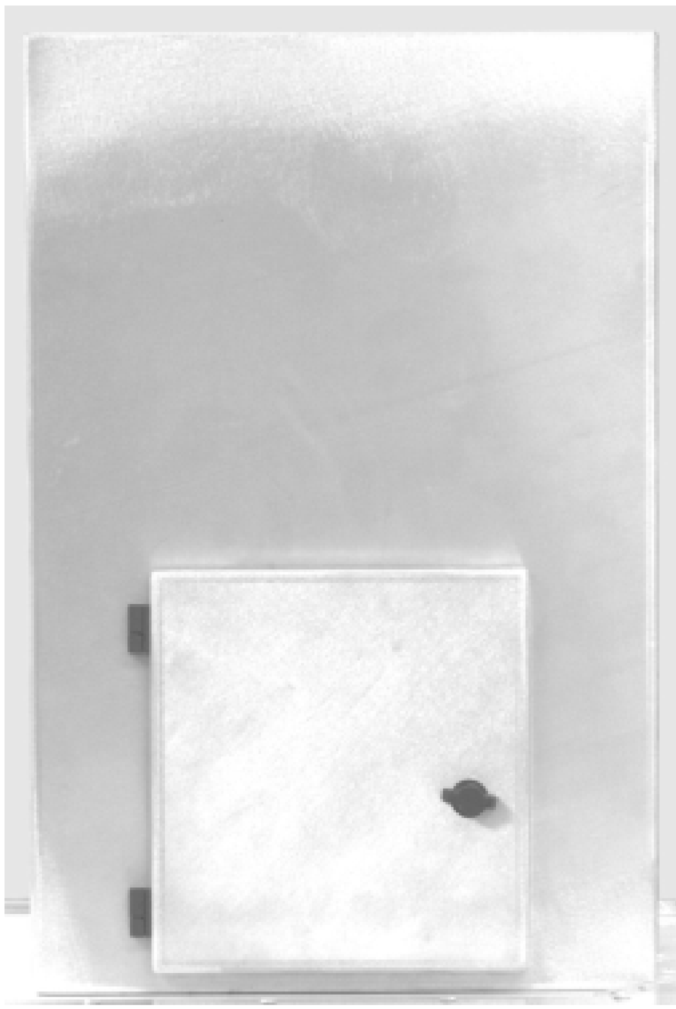
Figure K-25. Inside view of outdoor enclosure with spacer highlighted.

Figure K-26. Close-up view of the spacer.

6) **Place the Series 1400a control unit on the two angle-mounting brackets located in the top, left-hand corner of the enclosure (Figure K-25).**
7) **Place the SES module on the shelf located below the control unit.**
8) **Assemble the main flow and bypass flow connections (Section 2).**
9) **Install the 8500 module onto the Series 1400a sensor unit (Section 2).**
10) **Assemble the electrical and sensor unit connections (Section 2).**
11) **Secure the control unit to the rack angle uprights (Section 2).**

12) Locate the 8500 module enclosure (Figure K-27).

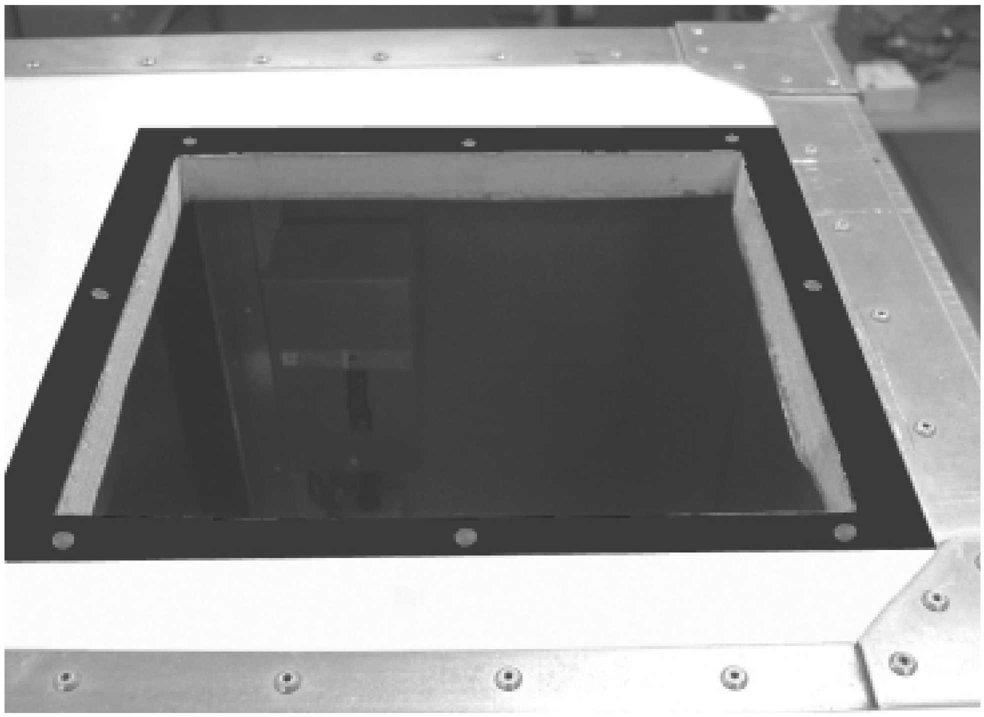
Figure K-27. 8500 module enclosure.



13) Locate one of the 8500 module enclosure gaskets (Section K.1)

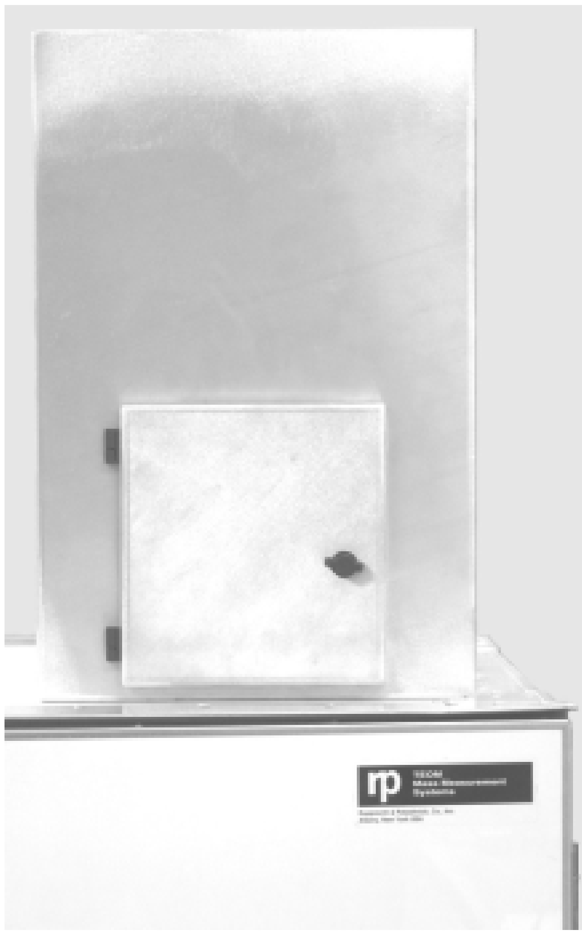
14) Place the gasket on the top of the outdoor enclosure and line up the holes in the gasket with the mounting holes in the enclosure (Figure K-28).

Figure K-28. Gasket on top of outdoor enclosure.



15) Place the 8500 module enclosure on top of the gasket (Section K-29) and line up the holes in the bottom of the 8500 module enclosure with the holes in the gasket.

Figure K-29. 8500 module enclosure on top of outdoor enclosure.

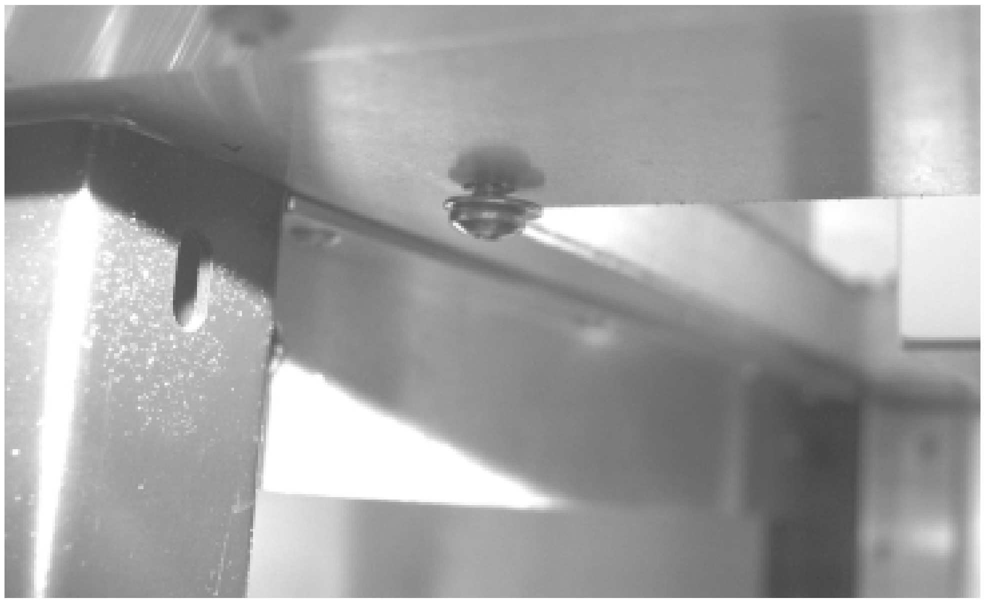


16) Locate the eight 1/4-20 x 1 1/2-inch pan-head screws and 1/4-inch flat washers (Section K.1).

17) Slide the eight flat washers over the eight pan-head screws.

18) Insert the eight screws with the flat washers up through the eight holes in the top of the outdoor enclosure. Do not tighten the front, left-hand screw (Figure K-30).

Figure K-30. Close-up view of the front left-hand screw.



19) Tighten the other seven screws that you installed. Go to Section K.5.1.1 (Flow Splitter Installation — Revision A 8500 Module).

K.5.1.1. Flow Splitter Installation — Revision A 8500 Module

The 8500 Roof Modification package includes a 3-meter length of 3/8-inch green nylon tubing (Section K.1). You will use this 3-meter length of tubing in steps 20-22 and 39. However, the Series 8500 FDMS Monitor system (and add-on kit) includes 5 m (16.5 ft) of 3/8-inch nylon green tubing in its compilation package (Section 2). You will use the 5 m length of tubing in steps 27-28, 33-35 and 38.

NOTE: The Series 8500 FDMS Monitor uses push-to-connect fittings for all air lines. To engage these connections, the air tube must be pushed completely into the fitting so that the tube is fully inserted and cannot be pulled out. While pushing the tubing into the fitting, there is an intermediate stop at an O-ring. You must push the tubing past the O-ring to completely engage the tubing inside the fitting and prevent air leaks. To disengage the connection, push the small collar (located at the end of the fitting) toward the fitting and pull the tube out.

Follow these steps to install the flow splitter into the outdoor enclosure:

1) Locate the flow splitter (Figures K-31 and K-32).

Figure K-31. Flow splitter.

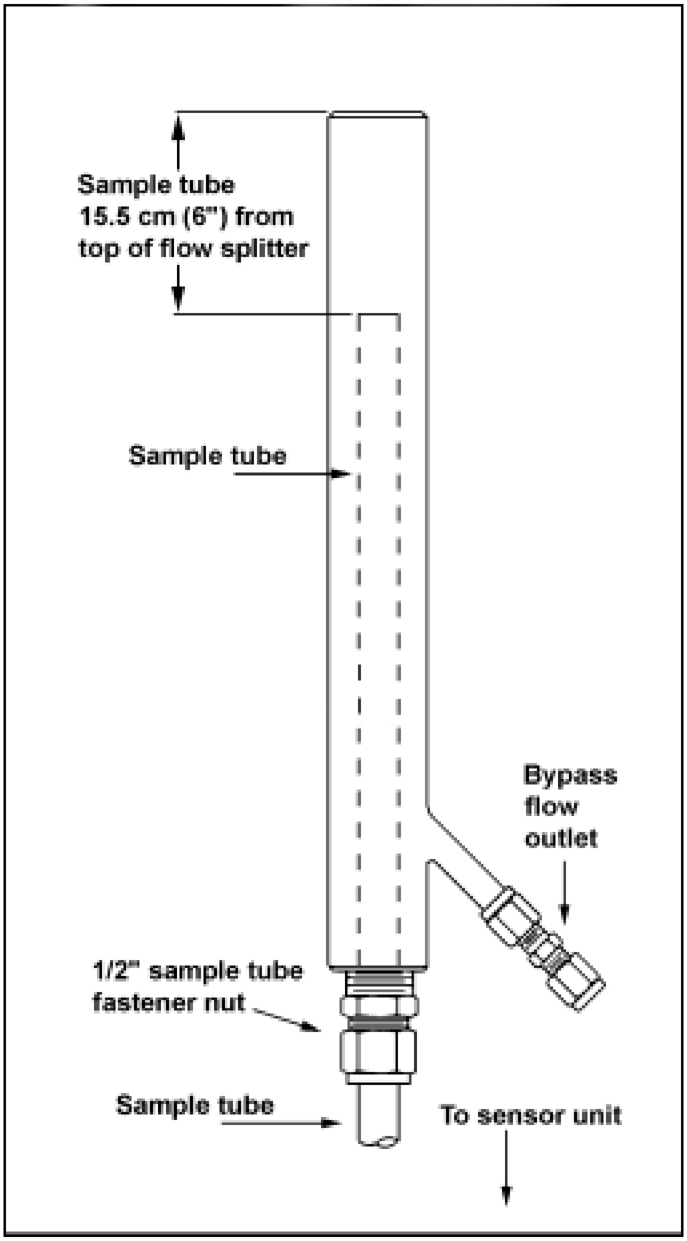
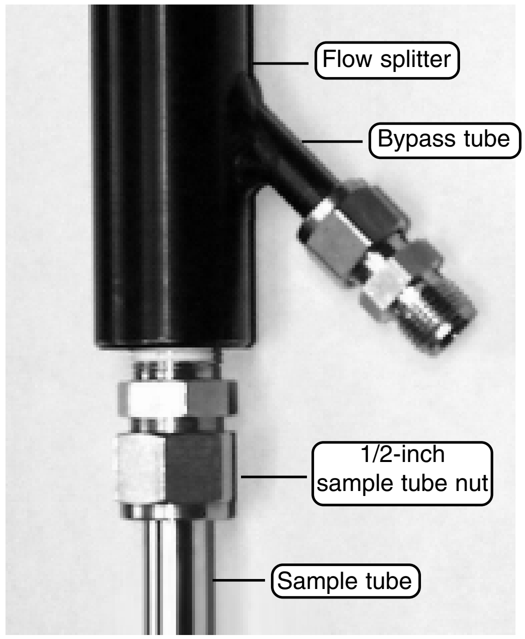


Figure K-32. Flow splitter drawing.

2) **Loosen the 1/2-inch sample tube nut at the base of the flow splitter (Figure K-33).**

Figure K-33. Close-up view of the bottom of the flow splitter.



3) **Remove the sample tube that is located inside the flow splitter.**

4) **Locate the 14-inch inlet tube (Figure K-34) and the metal, 1/2-inch push-to connect fitting and the plastic, 3/8-inch push-to-connect fitting (Figures K-35 and K-36).**

Figure K-34. 14-inch inlet tube.

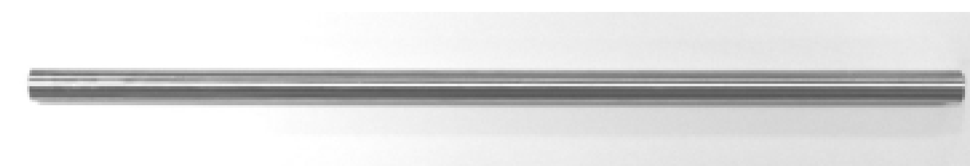
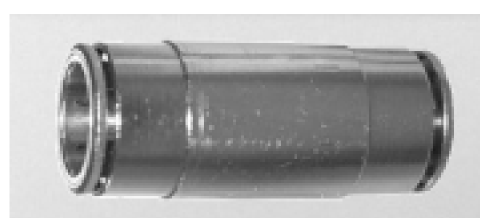


Figure K-35 (left). Plastic, 3/8-inch push-to-connect fitting.

Figure K-36 (right). Metal, 1/2-inch push-to-connect fitting.



5) Insert the 14-inch inlet tube into the flow splitter. Move the inlet tube up or down until it is 15.5 cm (6 inches) from the top of the flow splitter (Figure K-37).

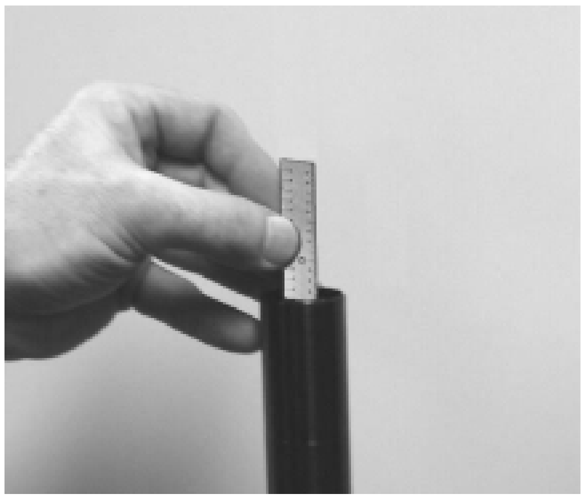


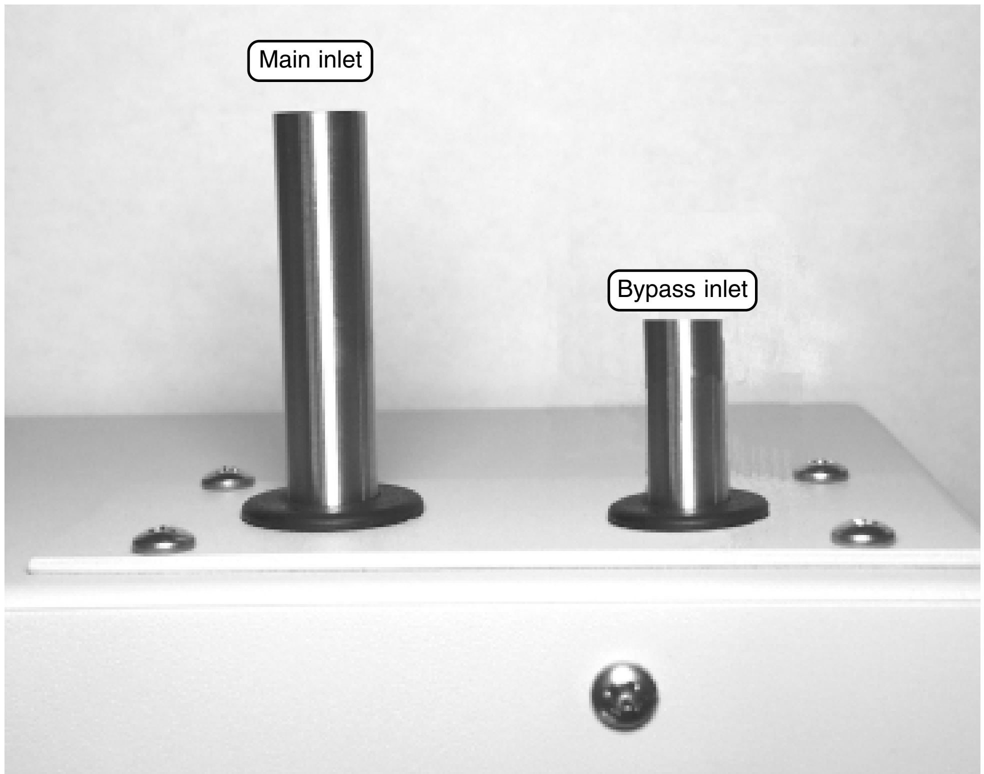
Figure K-37. Measuring the distance from the top of the inlet tube to the top of the flow splitter.

6) Tighten the 1/2-inch sample tube nut at the base of the flow splitter (Figures K-33 and K-38).

Figure K-38. Flow splitter with 14-inch inlet tube.

7) Locate the main inlet and bypass inlet on the top of the 8500 module (Figure K-39).

Figure K-39. Top of 8500 module with main inlet and bypass inlet.



8) Install the metal, 1/2-inch push-to-connect fitting onto the main inlet (Figure K-40).

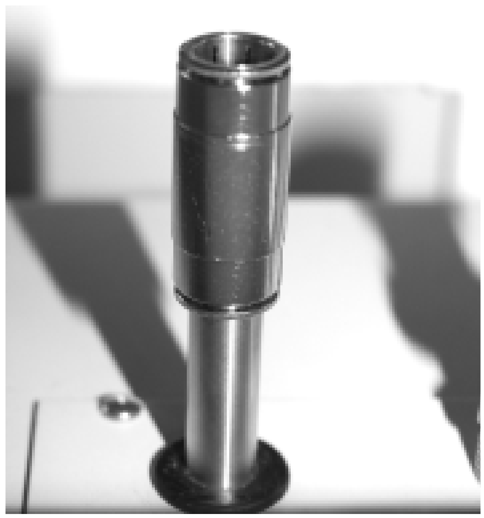


Figure K-40. Metal, 1/2-inch push-to-connect fitting installed on main inlet.

9) Install the plastic, 3/8-inch push-to-connect fitting onto the bypass inlet (Figure K-41).

Figure K-41. Plastic, 3/8-inch push-to-connect fitting installed on bypass inlet.

10) Locate the 8500 module enclosure cover (Figure K-42).

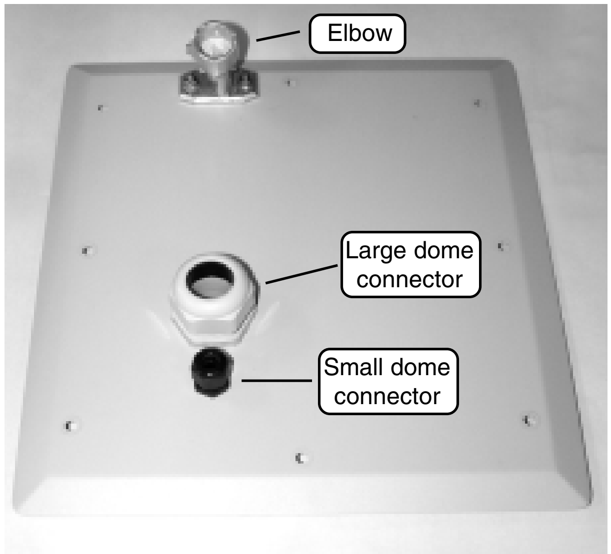


Figure K-42. 8500 module enclosure cover.

11) Locate the other 8500 module enclosure gasket (Section K.1).

12) Place the gasket on the top of the 8500 module enclosure and line up the holes in the gasket with the mounting holes in the module enclosure (Figure K-43).

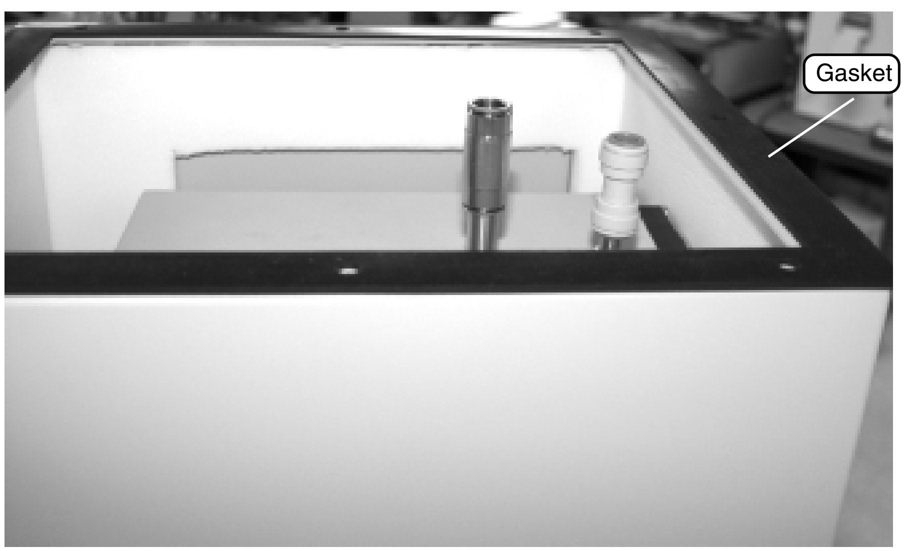


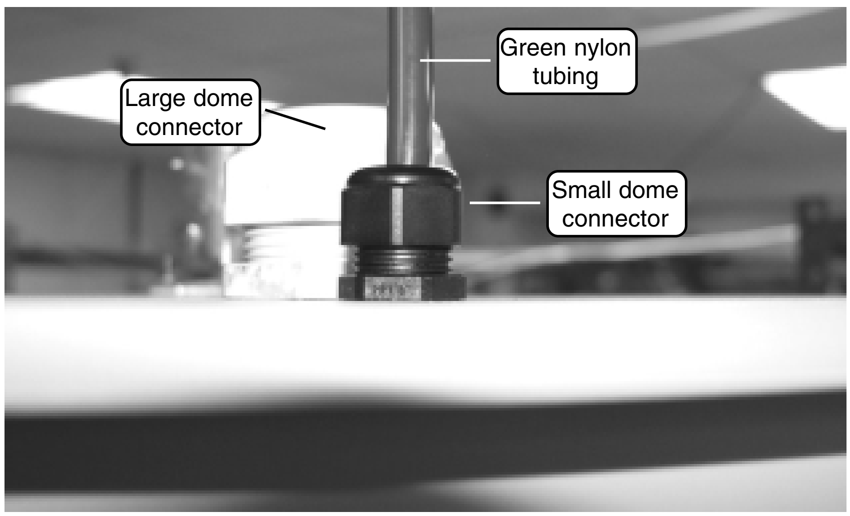
Figure K-43. Top of 8500 module enclosure with gasket installed.

13) Place the cover on top of the 8500 module enclosure. Make sure that the two dome connectors (Figure K-42) are lined up with the two push-to-connect fittings (Figures K-41 and K-43).

14) Locate the 18-inch length of the 3/8-inch green nylon tubing (Section K.1).

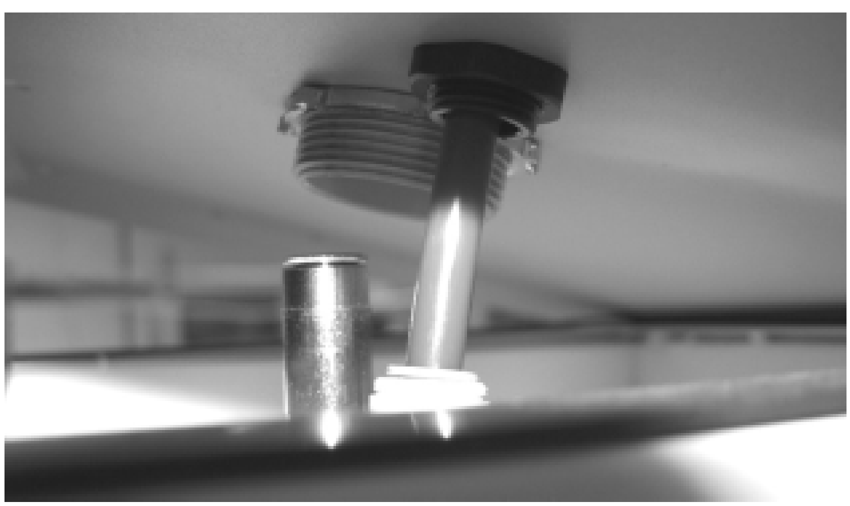
15) Install the nylon tubing into the small dome connector on the enclosure cover (Figure K-44).

Figure K-44. Green nylon tubing installed through the small dome connector.



16) Lift the cover slightly and install the nylon tubing into the plastic 3/8-inch push-to-connect fitting on the bypass inlet, on top of the 8500 module (Figure K-45).

Figure K-45. Green nylon tubing installed in the plastic, 3/8-inch push-to-connect fitting.



17) Set the cover down onto the top of the 8500 module enclosure. Ensure that the eight screw holes in the cover line up with the eight holes in the gasket (Figure K-43).

18) Locate the eight #10-32 x 3/4-inch pan-head screws, eight #10 flat washers and #10 flat sealing washers (Section K.1).

19) Slide the eight washers over the ends of the eight pan-head screws.

20) Slide the eight sealing washers over the ends of the eight pan-head screws.

21) Insert the screws with the washers down through the eight holes in the top of the 8500 module enclosure (Figures K-46 and K-47). Tighten the screws.

Figure K-46. Pan-head screw with flat washer and sealing washer.

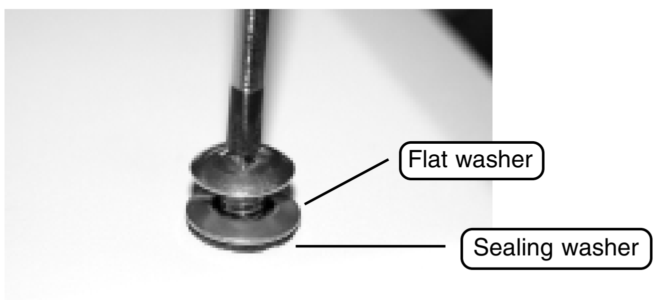
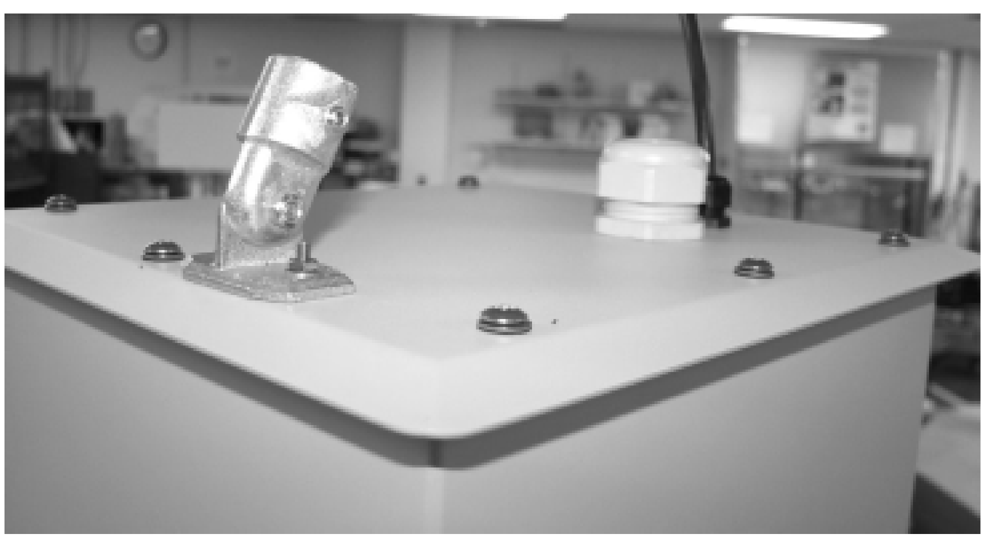
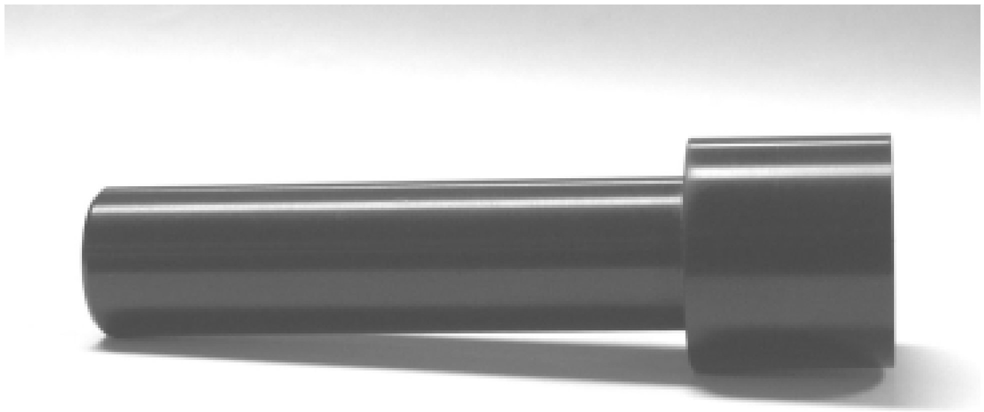


Figure K-47. 8500 module enclosure cover installed.



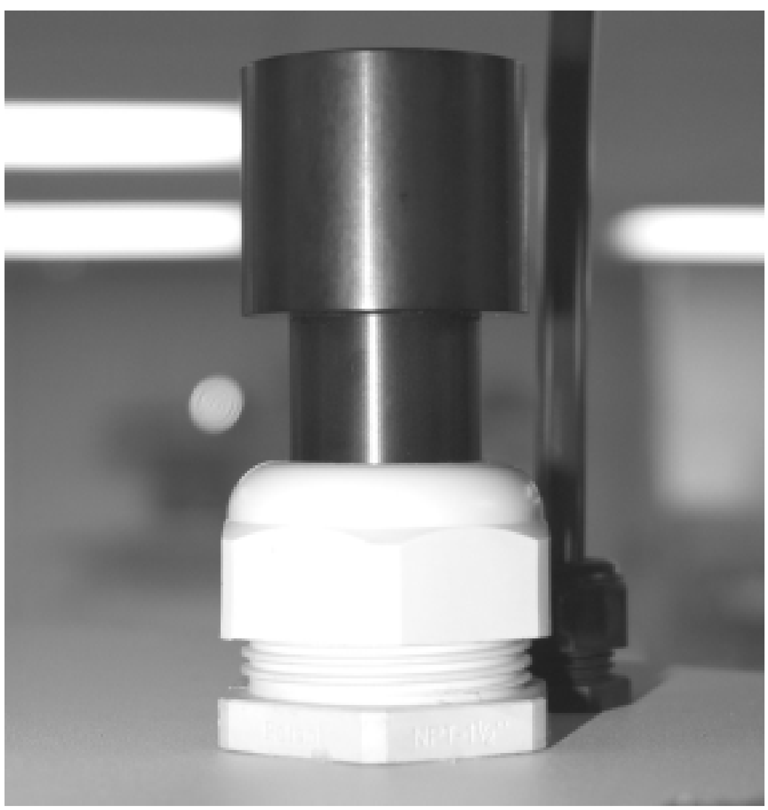
22) Locate the flow splitter extension (Figure K-48).

Figure K-48. Flow splitter extension.



23) Install the smaller end of the flow splitter extension into the large dome connector on the cover of the 8500 module enclosure (Figure K-49). Continue sliding the flow splitter extension down into the large dome connector until it hits a stop.

Figure K-49. Flow splitter extension installed in the large dome connector.



24) **Locate the flow splitter assembly (Figure K-38).**

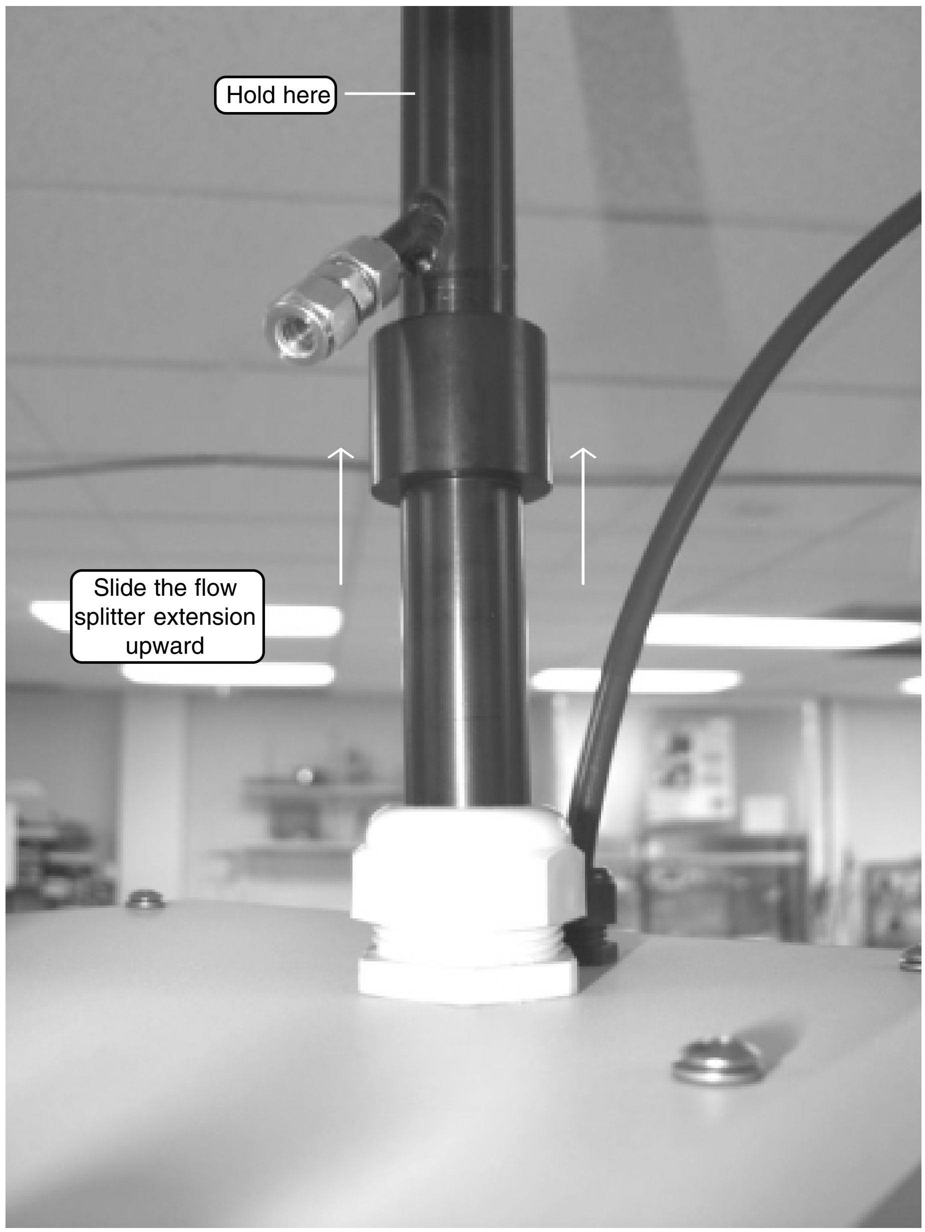
25) **Install the flow splitter assembly into the flow splitter extension (Figure K-50). Install the end of the inlet tube into the metal, 1/2-inch push-to-connect fitting that is attached to the top of the main inlet on the 8500 module.**

Figure K-50. Installing the flow splitter assembly into the flow splitter extension.

26) Hold the flow splitter assembly securely (Figure K-51).

27) Slide the flow splitter extension upward as far as it will go on the flow splitter (Figure K-51).

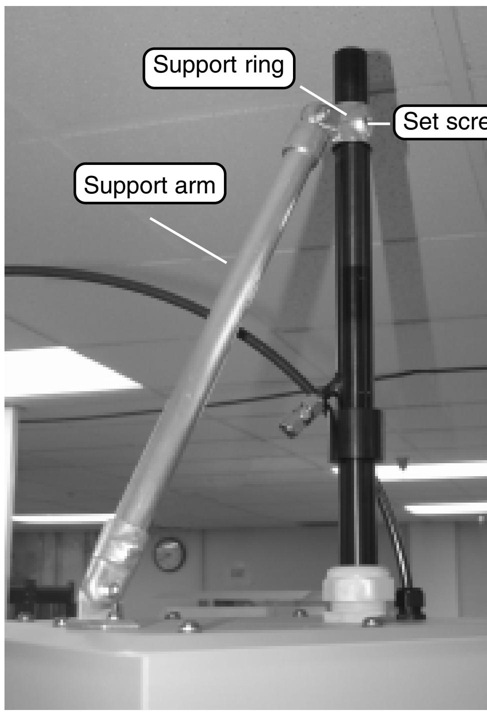
Figure K-51. Flow splitter extension pushed all the way up the flow splitter assembly.



28) **Tighten the dome connectors on the cover plate.**

29) **Locate the support arm (Section K.1).**

30) **Slide the support arm over the end of the flow splitter and install it into the elbow on the cover (Figures K-52 and K-53).**



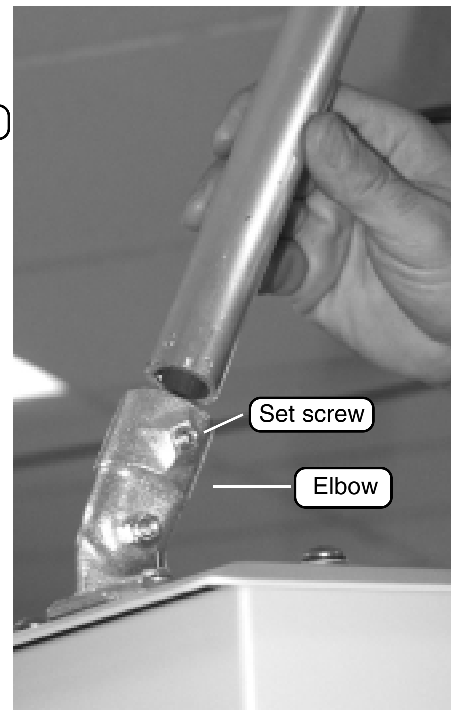


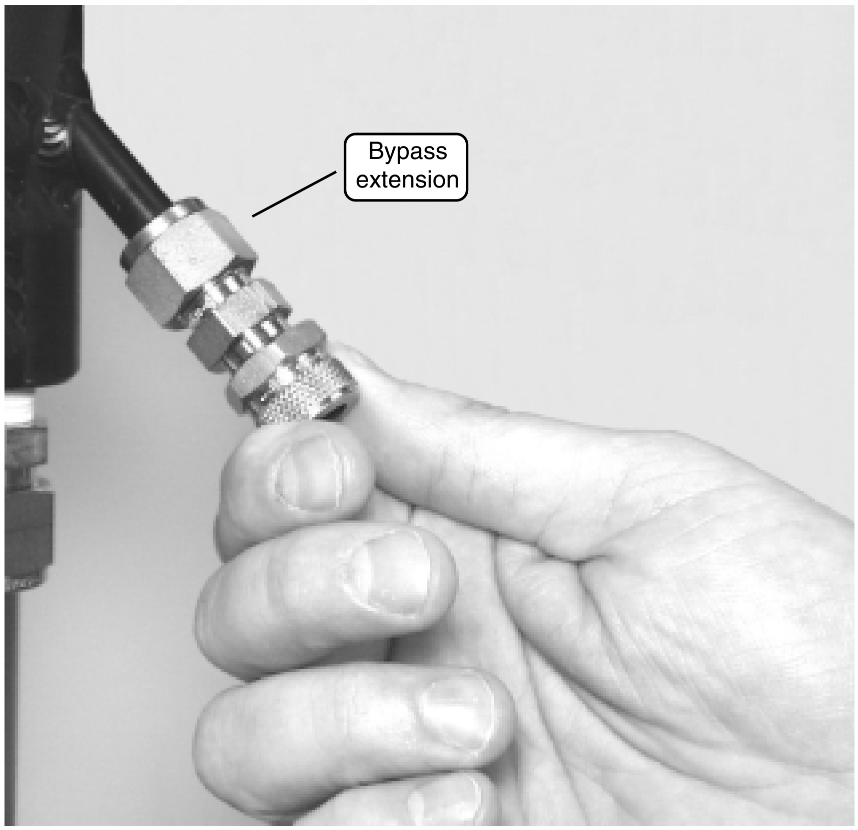
Figure K-52 (left). Support arm installed.

Figure K-53 (right). Close-up view of the elbow.

31) **Tighten the set screws in the elbow on the cover and in the support ring on the flow splitter (Figures K-52 and K-53).**

32) Locate the bypass extension on the flow splitter (Figures K-33 and 54).

Figure K-54. Removing the fastening nut from the bypass extension.



33) Remove the fastening nut from the bypass extension (Figure K-54) of the flow splitter.

34) **Remove the rubber ring from the bypass extension fastening nut (Figure K-55).**

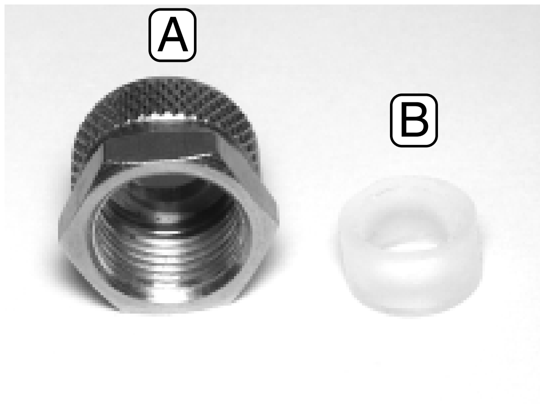


Figure K-55. Bypass extension fastening nut (A) and rubber ring (B).

35) **Install the bypass extension fastening nut onto the end of the nylon green tubing (Figure K-56). Ensure that the knurled or bumpy side of the bypass extension fastening nut is directed down the green bypass tubing, toward the top of the enclosure.**

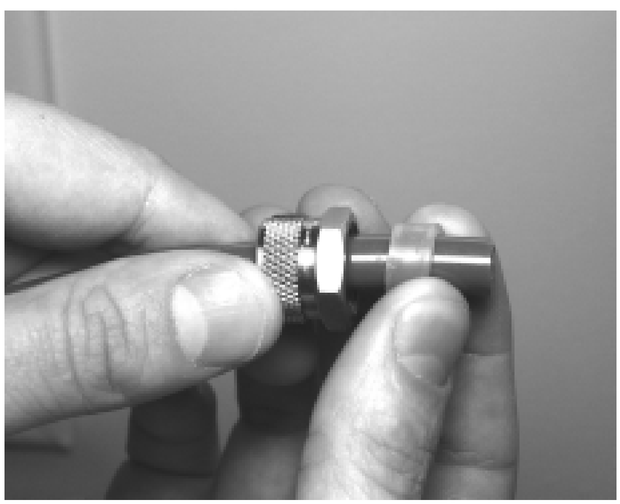


Figure K-56. Installing the bypass extension and rubber ring onto the green bypass tubing.

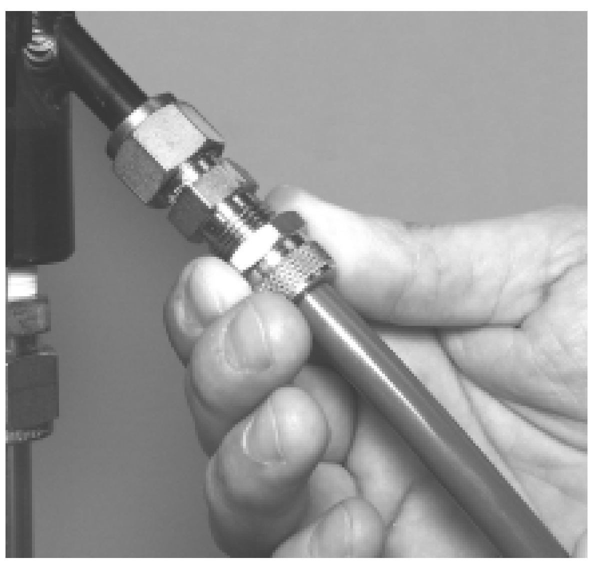
36) **Install the rubber ring onto the end of the green bypass tubing (Figure K-56). Ensure that the rubber ring is approximately 1/4-inch from the end of the green bypass tubing.**

37) Insert the green bypass tubing into the bypass extension (Figure K-57).

Figure K-57. Installing the green bypass tubing onto the bypass extension.

38) Tighten the bypass extension fastening nut onto the bypass extension (Figure K-58).

Figure K-58. Tightening the fastening nut onto the bypass extension.



39) Secure the control unit to the rack angle uprights (Figure K-25).

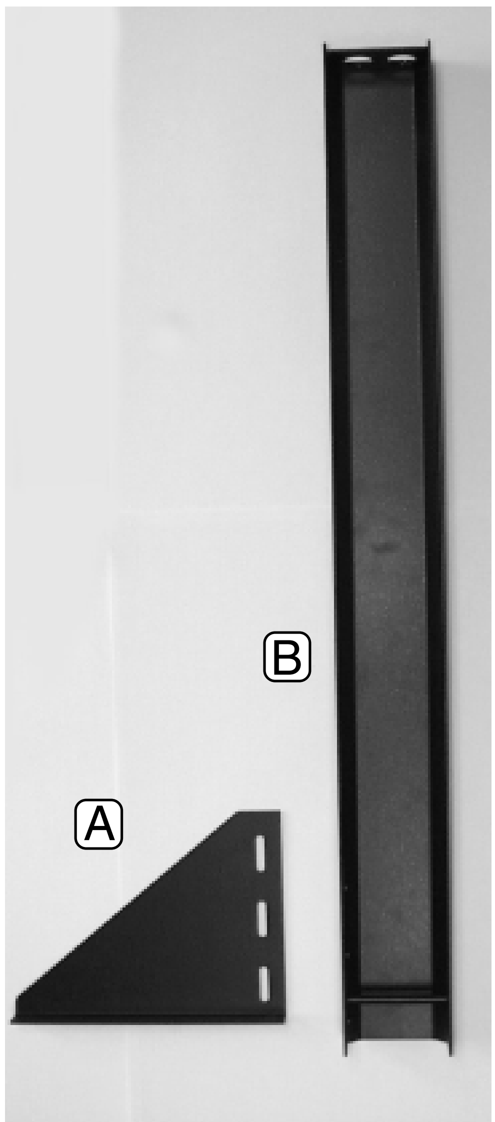
40) Go to Section K.6 (Circulating Fan Installation).

K.5.2. Installing a Revision B 8500 Module

Follow these steps to install a Revision B 8500 module into the outdoor enclosure:

1) Locate the 8500 module brace base and stand (Figure K-59).

Figure K-59. 8500 module brace base (A) and stand (B).



2) Install the brace base onto the brace stand with the brace stand channel facing TOWARD the base using the three 10/32 x 5/8 screws (Figures K-60 and K-61).

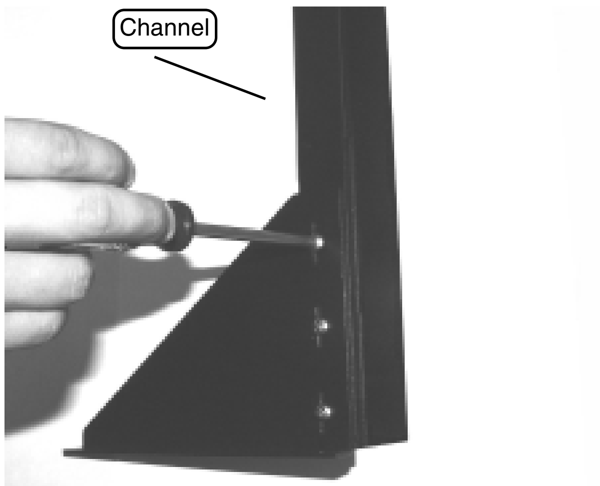


Figure K-60. Installing the brace base onto the brace stand.

Figure K-61. 8500 module brace.

3) Locate the four screws on top of the Series 1400a sensor unit that secure the sample inlet (Figure K-62).

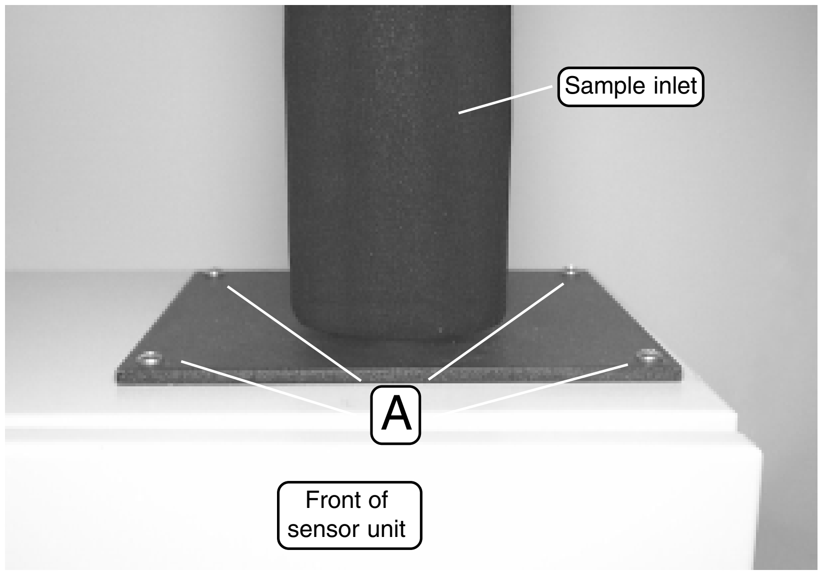


Figure K-62. Top of sensor unit with sample inlet mounting screws highlighted.

4) Remove the two mounting screws located on the left-hand side of the sample inlet (Figure K-63).

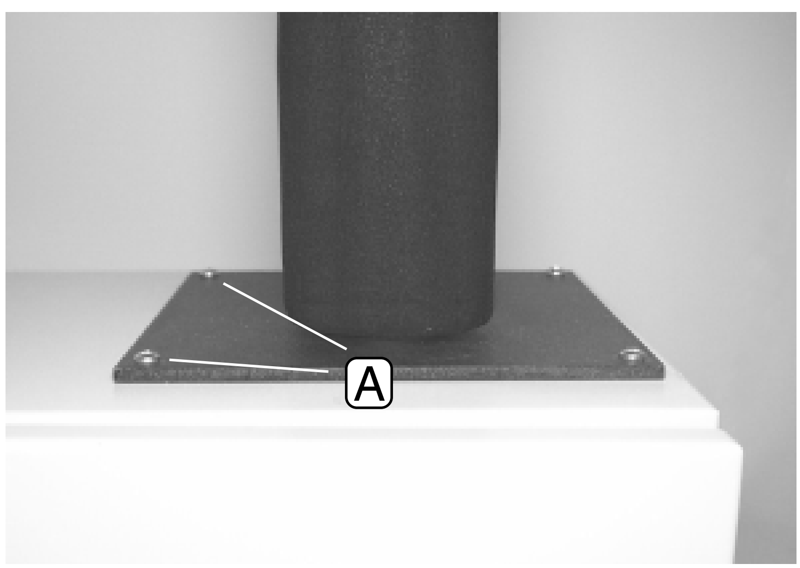


Figure K-63. Top of sensor unit with two left-hand sample inlet mounting screws highlighted.

5) Install the brace onto the top of the sensor unit using the two screws that you removed in step 4 (Figures K-64 and K-65).

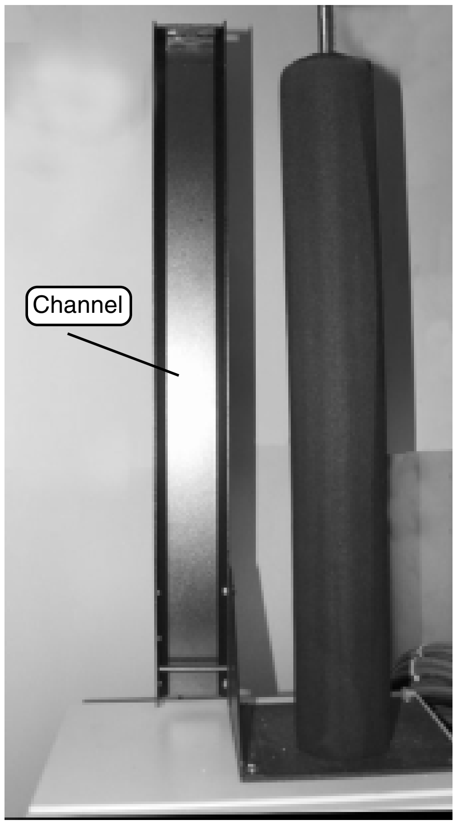
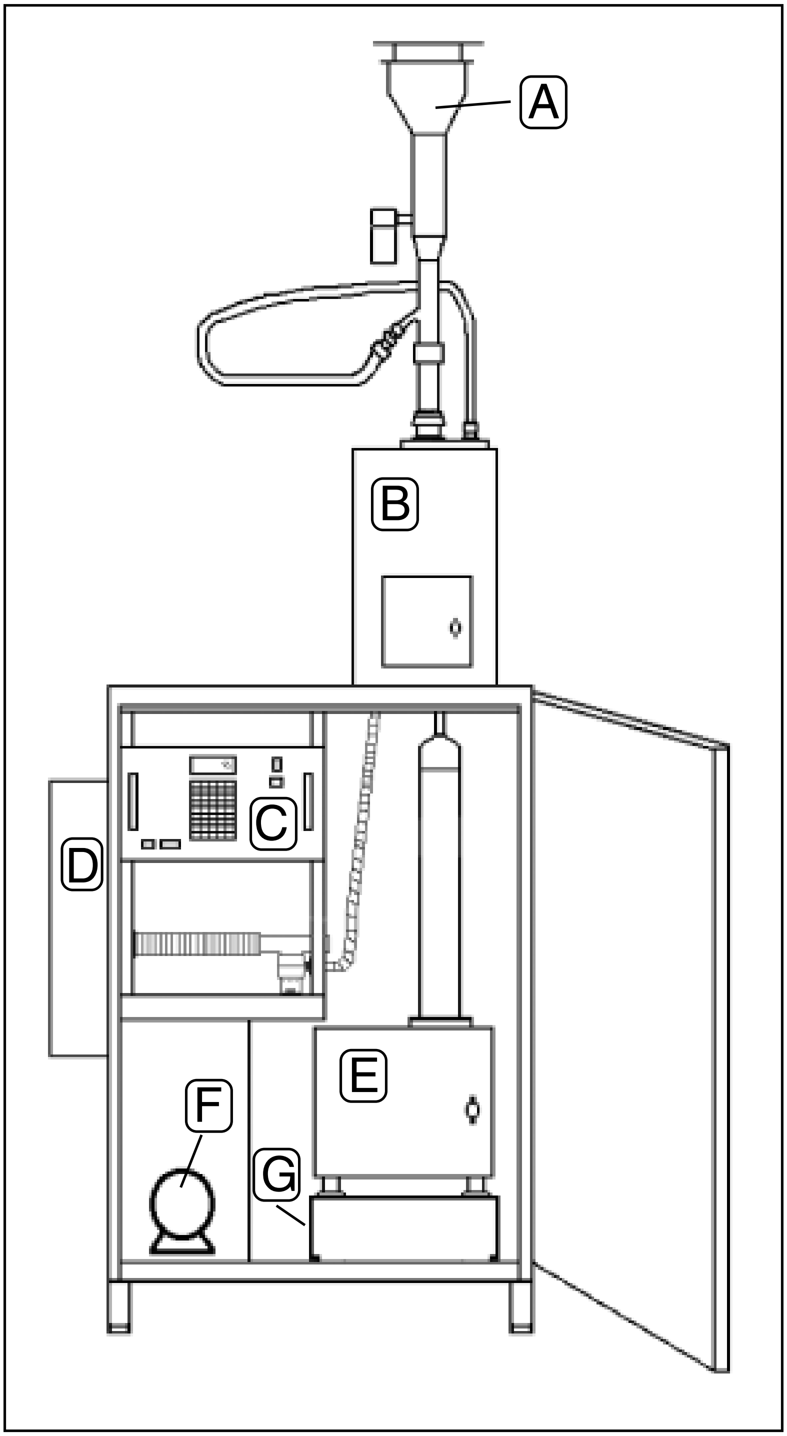


Figure K-64. Brace stand mounted on the sensor unit with the brace channel facing toward the front of the sensor unit.

Figure K-65. Close-up view of brace stand mounted onto the sensor unit.

6) Open the door of the outdoor enclosure (Figure K-66).

Figure K-66. Instrument placement inside the outdoor enclosure:
A: Sample inlet
B: 8500 module enclosure
C: Control unit
D: Air conditioner
E: Sensor unit
F: Pump
G: Spacer.



7) **Locate the sensor unit spacer (Section K.1).**

8) **Place the spacer on the bottom, right-hand side of the outdoor enclosure (Figures K-67 and K-68).**

Figure K-67. Inside view of outdoor enclosure with spacer highlighted.

Figure K-68. Close-up view of the spacer.

9) Place the Series 1400a sensor unit on top of the spacer (Figures K-67 and K-68).

10) Locate the 8500 module (Figure K-69).

Figure K-69. 8500 module.

11) Install the 8500 module through the square hole in the top of the enclosure.

12) Install the purge flow inlet and outlet ports of the 8500 module into the top of the brace (Figure K-70).

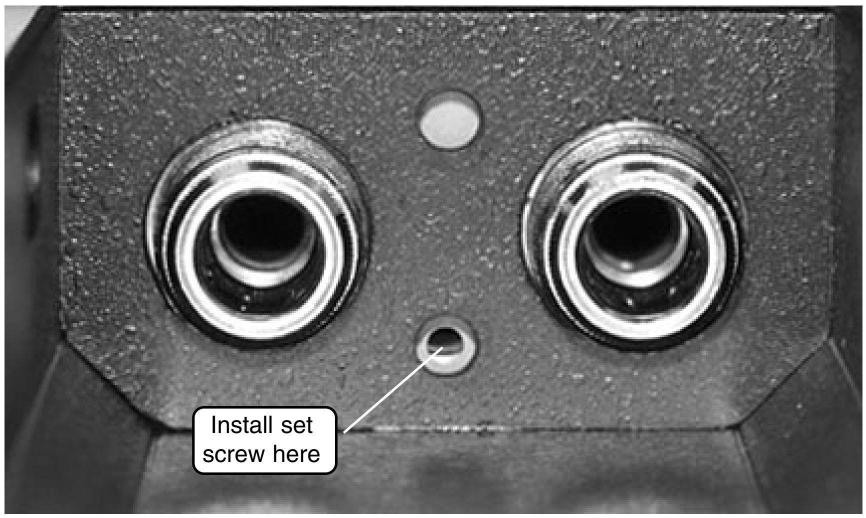


Figure K-70. Purge flow inlet and outlet ports installed into top of brace.

13) Locate the set screw that is attached to the brace.

14) Install the set screw into the hole in the top of the brace (Figures K-70 and K-71).

NOTE: There are two holes in the top of the brace. Install the set screw into the hole that is closer to the back of the 8500 module.

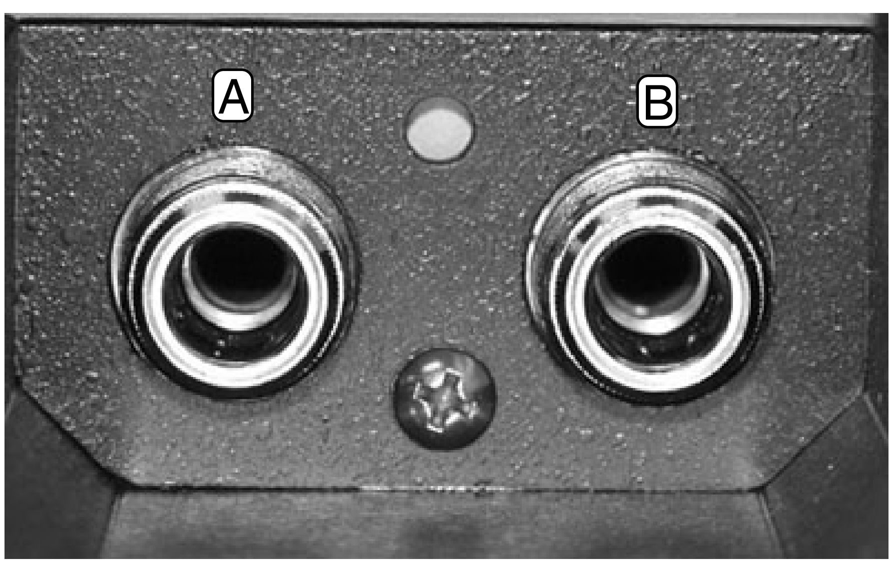
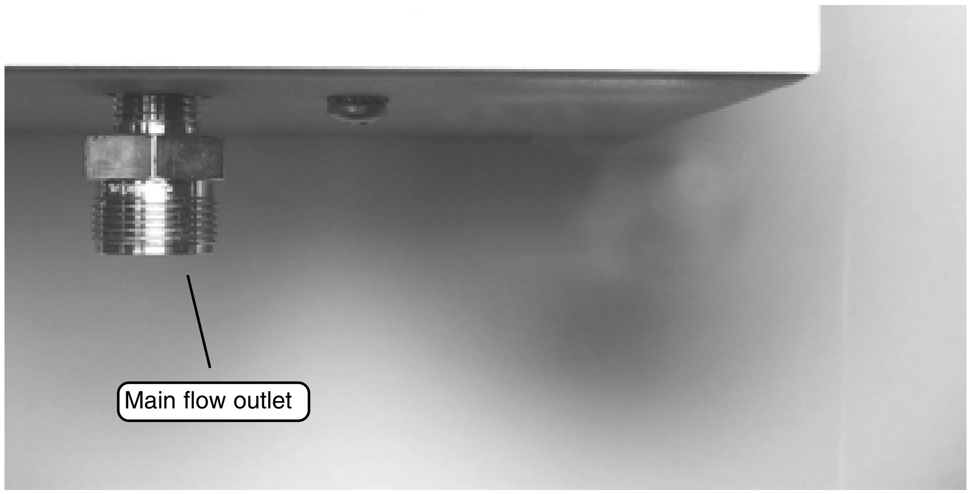


Figure K-71. Set screw installed into the 8500 module near the purge flow outlet port (A) and the purge flow inlet port (B).

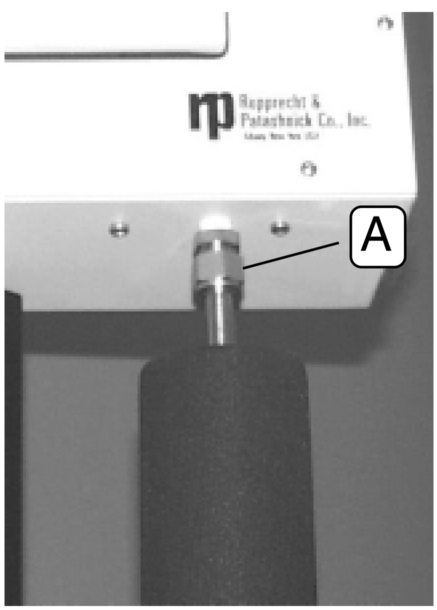
15) Locate the main flow outlet port on the bottom, right-hand corner of the 8500 module (Figure K-72).

Figure K-72. Close-up view of main flow outlet on the bottom of the 8500 module.



16) Install the 8500 module's main flow outlet port onto the sample inlet of the sensor unit (Figure K-73). Be sure to tighten the Swagelok fitting 1-1/4 turn past finger-tight with a wrench.

Figure K-73. 8500 module's main flow outlet port installed onto the sample inlet of the sensor unit (A).



17) Place the Series 1400a control unit on the two angle-mounting brackets located in the upper, left-hand corner of the enclosure (Figure K-67).

18) Install the electrical connections for the 8500 module (Section 2.4.4).

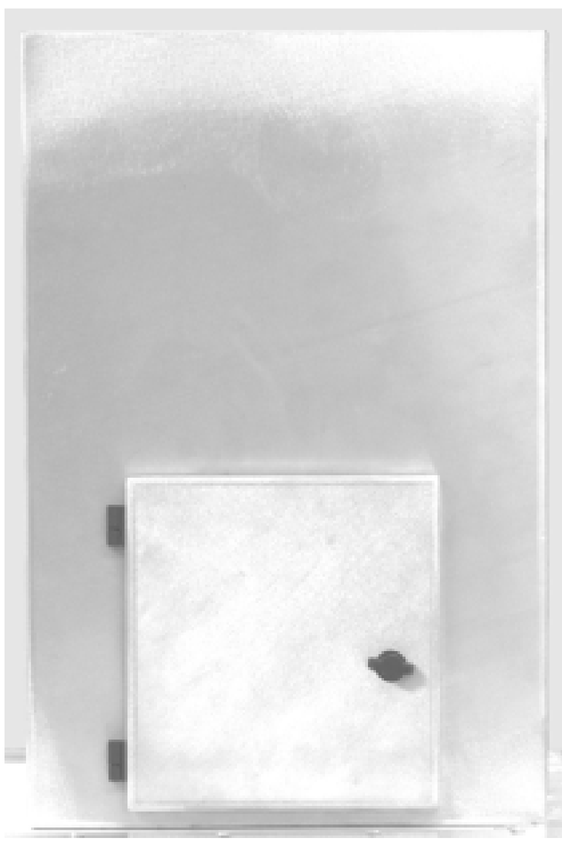
19) Assemble the main flow connections (Section 2.4.3.1).

20) Assemble the electrical connections (Section 2.4.5).

21) Assemble the sensor unit connections (Section 2.4.6).

22) Locate the 8500 module enclosure (Figure K-74).

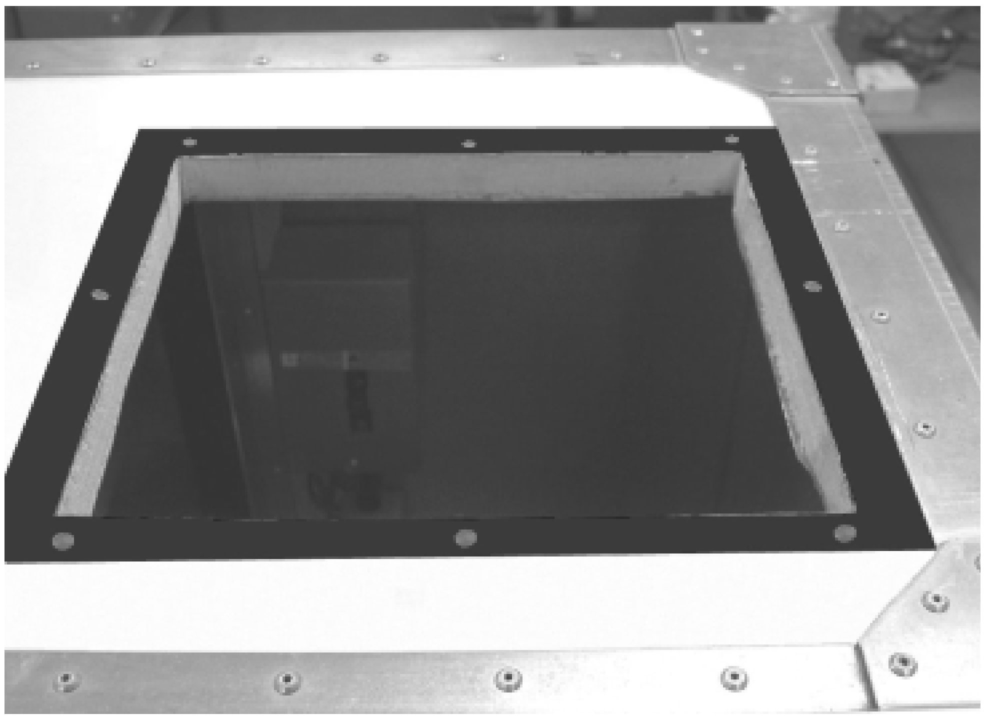
Figure K-74. 8500 module enclosure.



23) Locate one of the 8500 module enclosure gaskets (Section K.1).

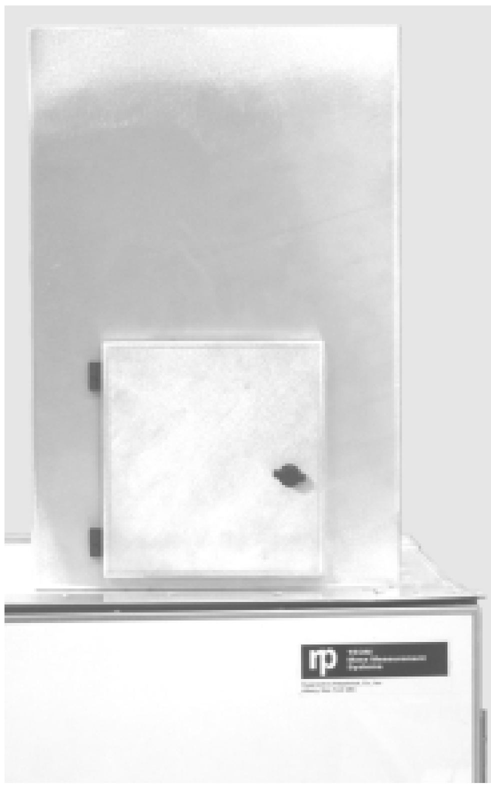
24) Place the gasket on the top of the outdoor enclosure and line up the holes in the gasket with the mounting holes in the enclosure (Figure K-75).

Figure K-75. Gasket on top of outdoor enclosure.



25) **Place the 8500 module enclosure on top of the gasket (Section K-76) and line up the holes in the bottom of the 8500 module enclosure with the holes in the gasket.**

Figure K-76. 8500 module enclosure on top of outdoor enclosure.

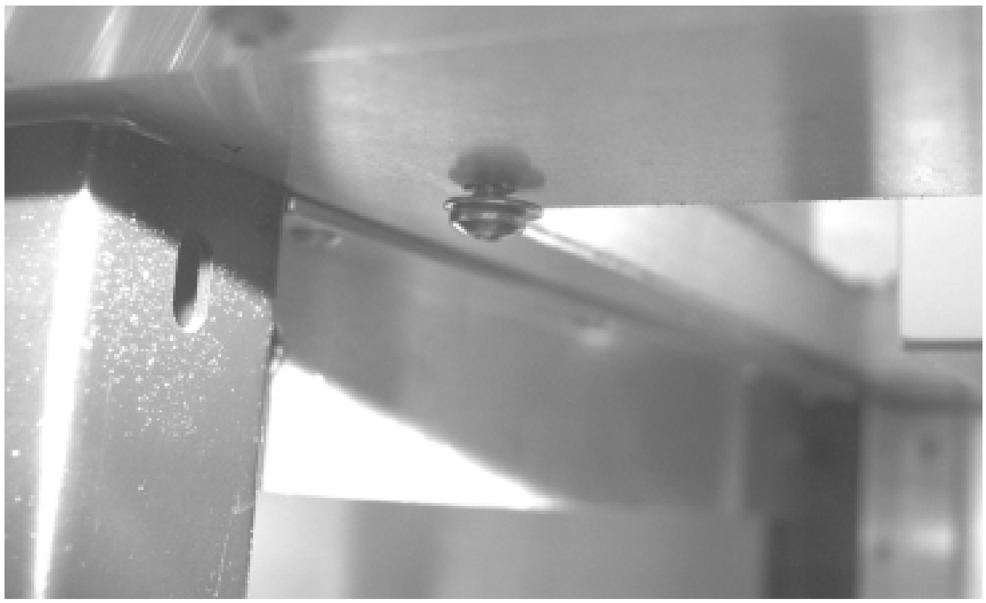


26) **Locate the eight 1/4-20 x 1 1/2-inch pan-head screws and 1/4-inch flat washers (Section K.1).**

27) **Slide the eight flat washers over the eight pan-head screws.**

28) Insert the eight screws with the flat washers up through the eight holes in the top of the outdoor enclosure. Do not tighten the front, left-hand screw (Figure K-77).

Figure K-77. Close-up view of the front left-hand screw.



29) Tighten the other seven screws that you installed. Go to Section K.5.2.1 (Flow Splitter Installation — Revision B 8500 Module).

K.5.2.1. Flow Splitter Installation — Revision B 8500 Module

The 8500 Roof Modification package includes a 3-meter length of 3/8-inch green nylon tubing (Section K.1). You will use this 3-meter length of tubing in steps 20-22 and 39. However, the Series 8500 FDMS Monitor system (and add-on kit) includes 5 m (16.5ft) of 3/8-inch nylon green tubing in its compilation package (Section 2). You will use the 5 m length of tubing in steps 27-28, 33-35 and 38.

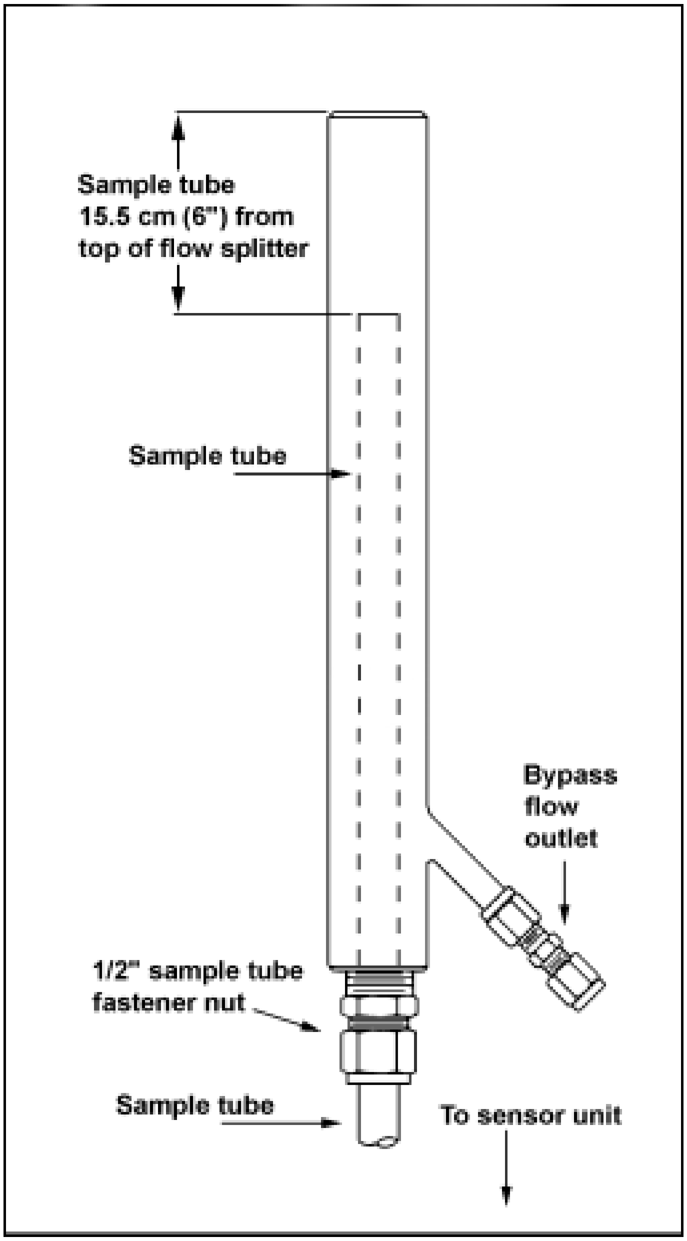
> NOTE: The Series 8500 FDMS Monitor uses push-to-connect fittings for all air lines. To engage these connections, the air tube must be pushed completely into the fitting so that the tube is fully inserted and cannot be pulled out. While pushing the tubing into the fitting, there is an intermediate stop at an O-ring. You must push the tubing past the O-ring to completely engage the tubing inside the fitting and prevent air leaks. To disengage the connection, push the small collar (located at the end of the fitting) toward the fitting and pull the tube out.

Follow these steps to install the flow splitter into the outdoor enclosure:

1) Locate the flow splitter (Figures K-78 and K-79).

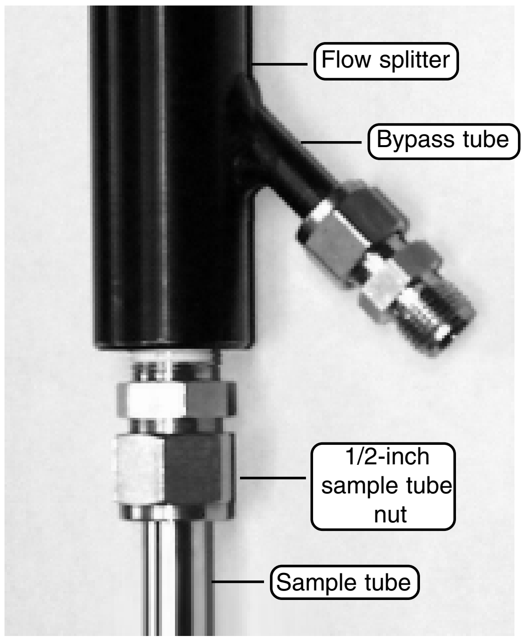
Figure K-78. Flow splitter.

Figure K-79. Flow splitter drawing.



2) Loosen the 1/2-inch sample tube nut at the base of the flow splitter (Figure K-80).

Figure K-80. Close-up view of the bottom of the flow splitter.



3) Remove the sample tube that is located inside the flow splitter.

4) Locate the 14-inch inlet tube (Figure K-81) and the metal, 1/2-inch push-to-connect fitting (Figure K-82).

Figure K-81. 14-inch inlet tube.

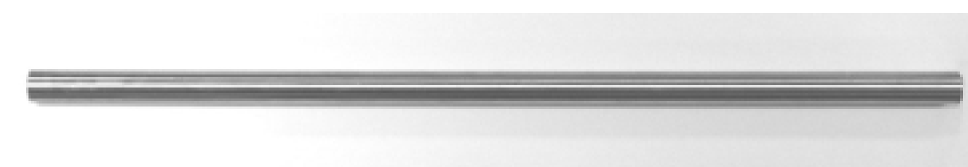


Figure K-82. Metal, 1/2-inch push-to-connect fitting.

5) **Insert the 14-inch inlet tube into the flow splitter. Move the inlet tube up or down until it is 15.5 cm (6 inches) from the top of the flow splitter (Figure K-83).**

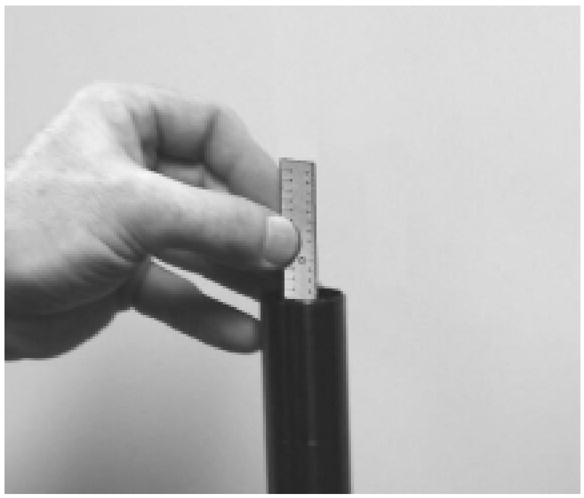


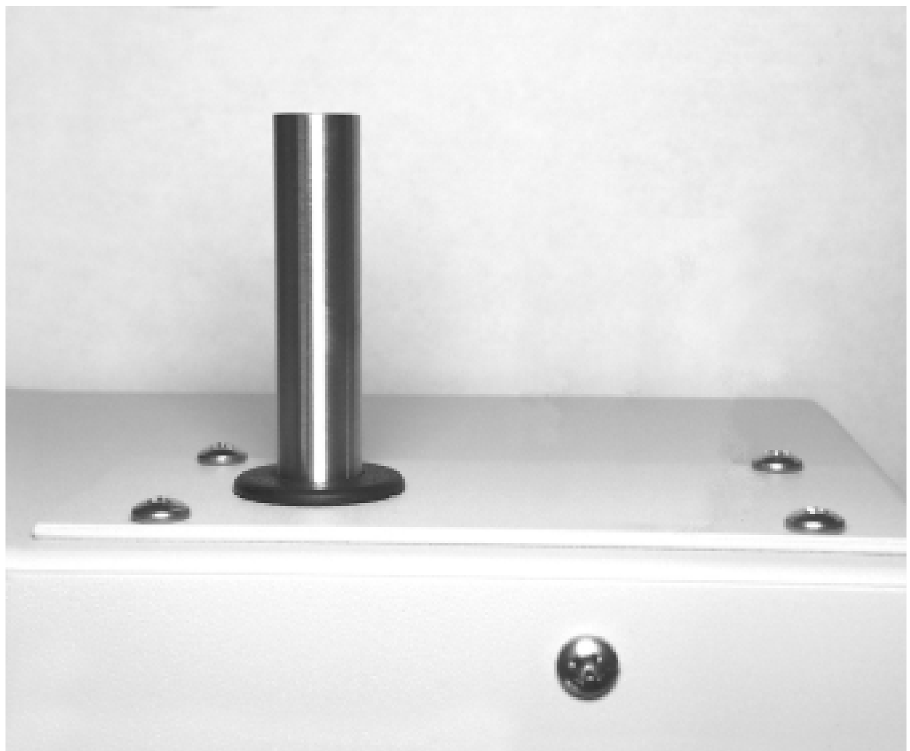
Figure K-83. Measuring the distance from the top of the inlet tube to the top of the flow splitter.

6) **Tighten the 1/2-inch sample tube nut at the base of the flow splitter (Figures K-80 and K-84).**

Figure K-84. Flow splitter with 14-inch inlet tube.

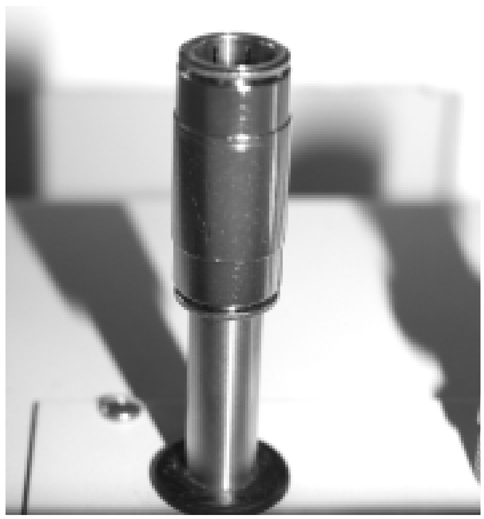
7) Locate the main inlet on the top of the 8500 module (Figure K-85).

Figure K-85. Top of 8500 module with main inlet.



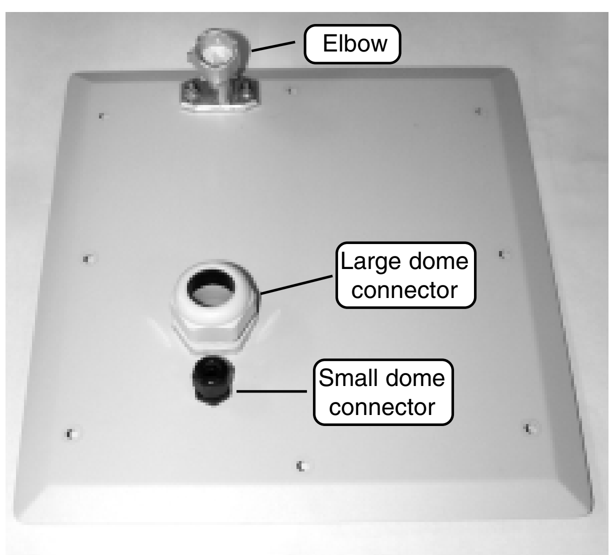
8) Install the metal, 1/2-inch push-to-connect fitting onto the main inlet (Figure K-86).

Figure K-86. Metal, 1/2-inch push-to-connect fitting installed on main inlet.



9) Locate the 8500 module enclosure cover (Figure K-87).

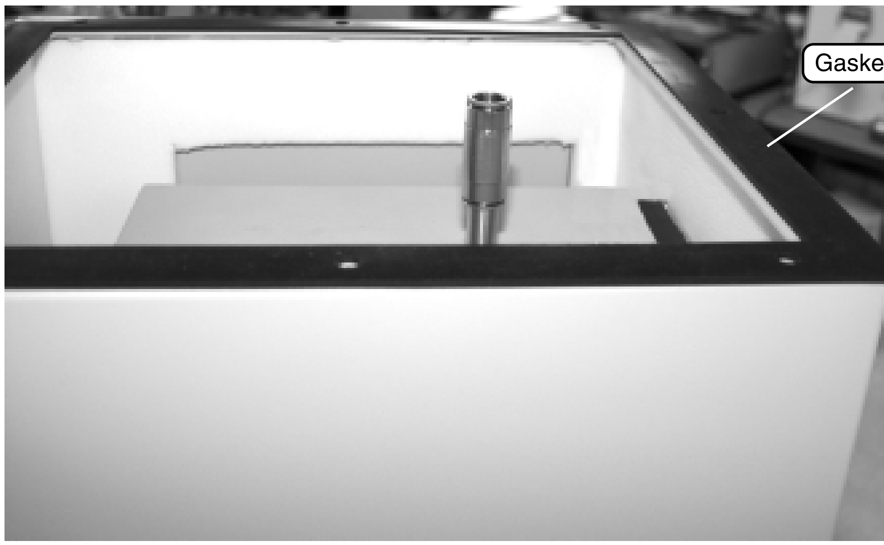
Figure K-87. 8500 module enclosure cover.



10) Locate the other 8500 module enclosure gasket (Section K.1).

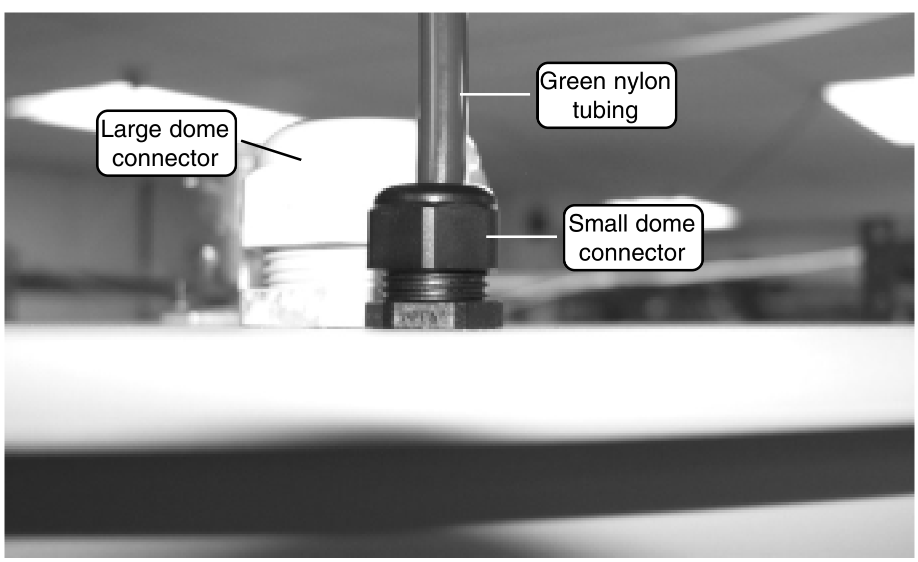
11) Place the gasket on the top of the 8500 module enclosure and line up the holes in the gasket with the mounting holes in the module enclosure (Figure K-88).

Figure K-88. Top of 8500 module enclosure with gasket installed.



12) Place the 8500 module enclosure cover on top of the 8500 module enclosure. Make sure that the large dome connector (Figure K-89) is lined up with the push-to-connect fitting (Figure K-88).

Figure K-89. Green nylon tubing installed through the small dome connector.



13) **Locate the 3/8-inch green nylon tubing (Section K.1). Cut a piece of tubing that is long enough to reach from the flow splitter to the back of the control unit inside the enclosure.**

14) **Install the green nylon tubing into the small dome connector on the cover (Figure K-89).**

15) **Lift the cover slightly and pull the green nylon tubing through the small dome connector (Figure K-90). Continue pulling the tubing down through the small dome connector until the end of the tubing reaches the back of the control unit.**

Figure K-90. Green nylon tubing running through the small dome connector and down through the enclosure.

16) **Install the bypass flow connections in the back of the control unit (Section 2.4.3.2).**

17) **Set the cover down onto the top of the 8500 module enclosure (Figure K-88). Ensure that the eight screw holes in the cover line up with the eight holes in the gasket.**

18) **Locate the eight #10-32 x 3/4-inch pan-head screws, eight #10 flat washers and eight #10 flat sealing washers (Section K.1).**

19) **Slide the eight washers over the ends of the eight pan-head screws.**

20) **Insert the screws with the washers down through the eight holes in the 8500 module enclosure cover. Tighten the screws (Figure K-91 and K-92).**

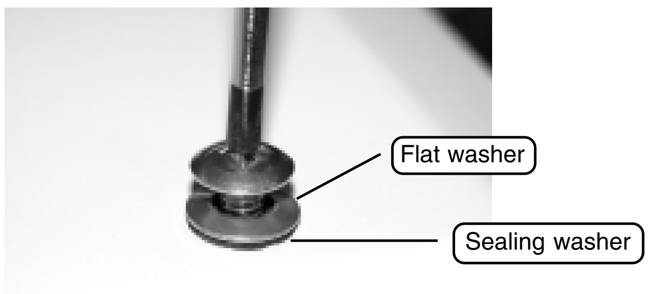


Figure K-91. Pan-head screw with flat washer and sealing washer.

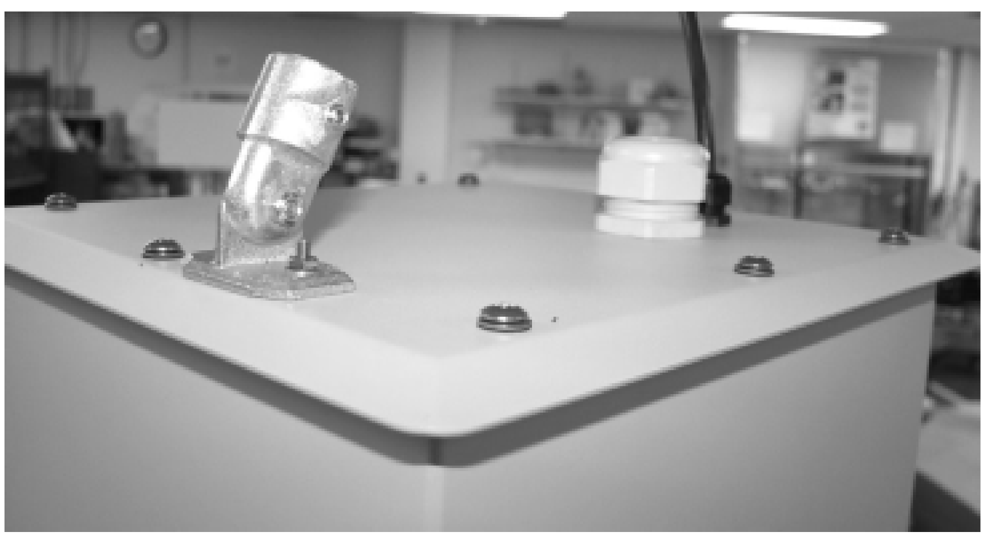


Figure K-92. 8500 module enclosure cover installed.

21) Locate the flow splitter extension (Figure K-93).

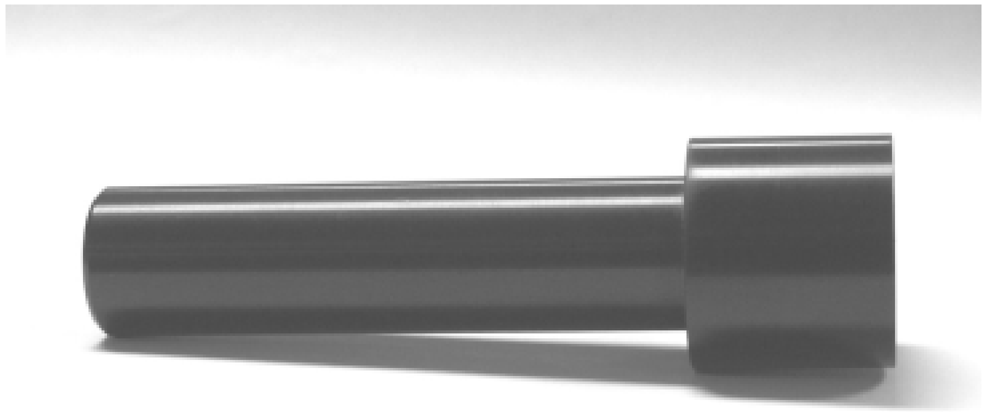


Figure K-93. Flow splitter extension.

22) Install the smaller end of the flow splitter extension into the large dome connector on the cover of the 8500 module enclosure (Figure K-94). Continue sliding the flow splitter extension down into the large dome connector until it hits a stop.

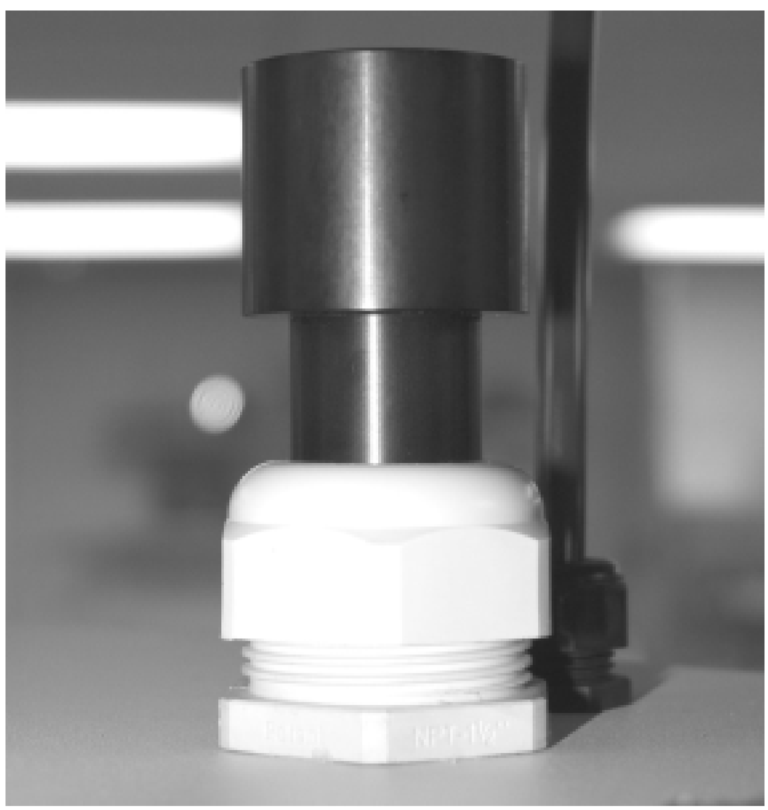


Figure K-94. Flow splitter extension installed in the large dome connector.

23) Locate the flow splitter assembly (Figure K-79).

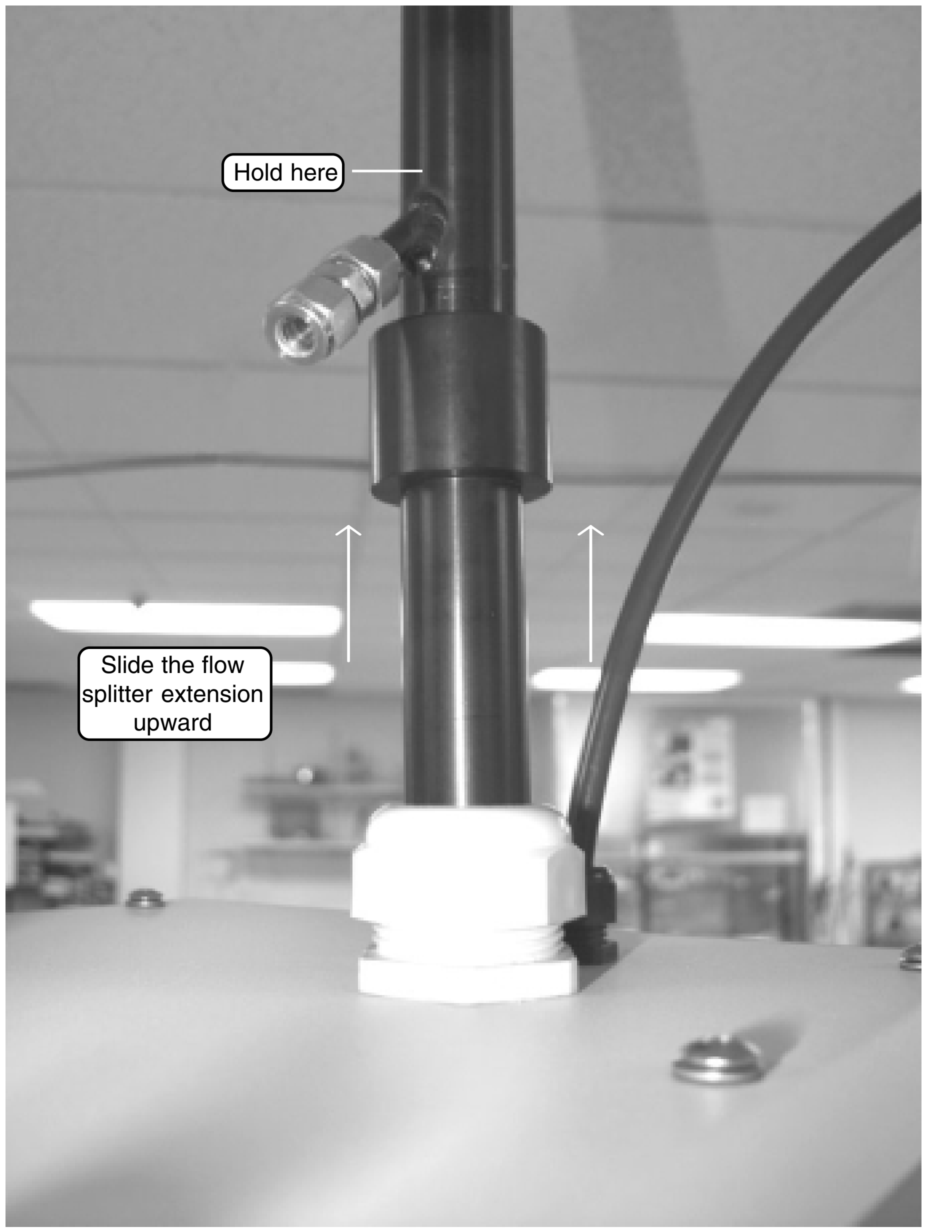
24) Install the flow splitter assembly into the flow splitter extension (Figure K-95). Install the end of the inlet tube into the metal, 1/2-inch push-to-connect fitting that is attached to the top of the main inlet on the 8500 module.

Figure K-95. Installing the flow splitter assembly into the flow splitter extension.

25) Hold the flow splitter assembly securely (Figure K-96).

26) Slide the flow splitter extension upward as far as it will go on the flow splitter (Figure K-96).

Figure K-96. Flow splitter extension pushed all the way up the flow splitter assembly.



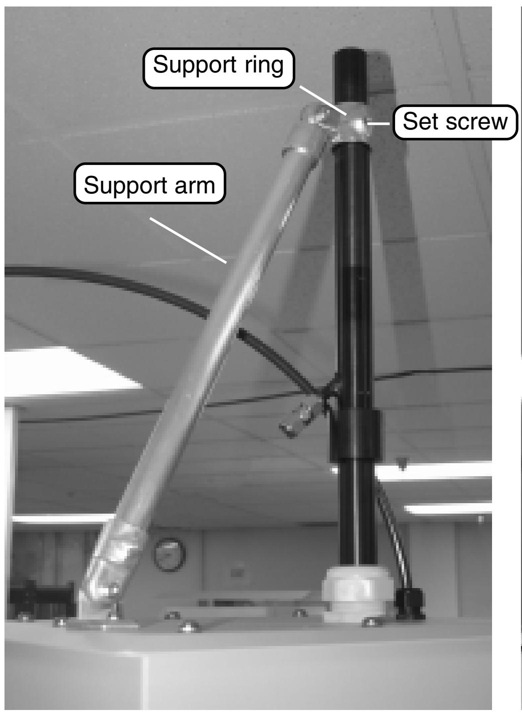
27) Tighten the dome connectors on the cover plate.

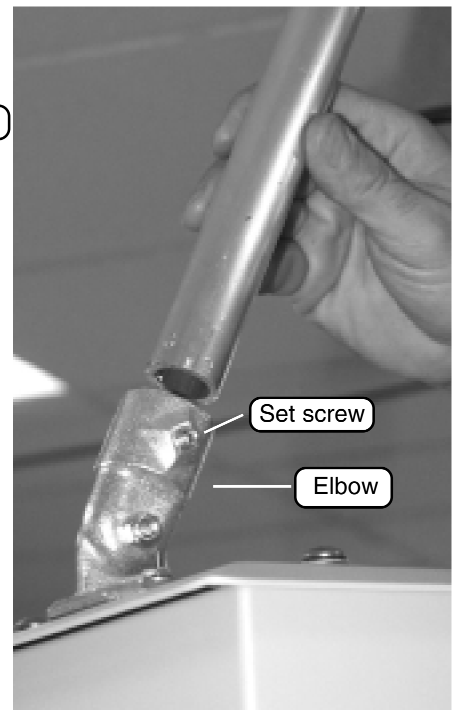
28) Locate the support arm (Section K.1).

29) Slide the support arm over the end of the flow splitter and install it into the elbow on the cover (Figures K-97 and K-98).

Figure K-97 (left). Support arm installed.

Figure K-98 (right). Close-up view of the elbow.





30) Tighten the set screws in the elbow on the cover and in the support ring on the flow splitter (Figures K-97 and K-98).

31) **Locate the bypass extension on the flow splitter (Figures K-79 and 99).**

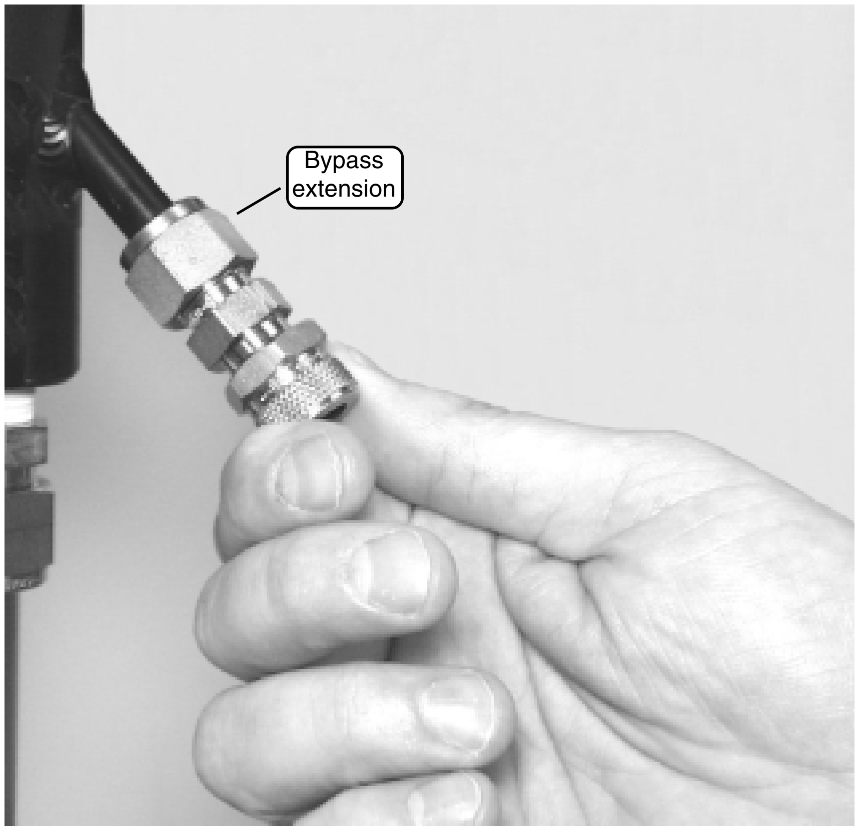


Figure K-99. Removing the fastening nut from the bypass extension.

32) **Remove the fastening nut from the bypass extension (Figure K-99) of the flow splitter.**

33) Remove the rubber ring from the bypass extension fastening nut (Figure K-100).

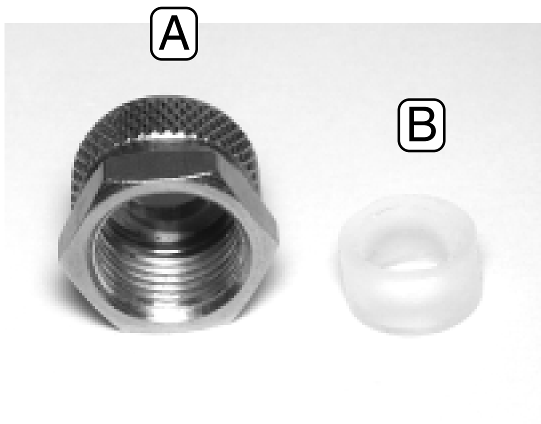


Figure K-100. Bypass extension fastening nut (A) and rubber ring (B).

34) Install the bypass extension fastening nut onto the end of the nylon green tubing (Figure K-101). Ensure that the knurled or bumpy side of the bypass extension fastening nut is directed down the green bypass tubing, toward the top of the enclosure.

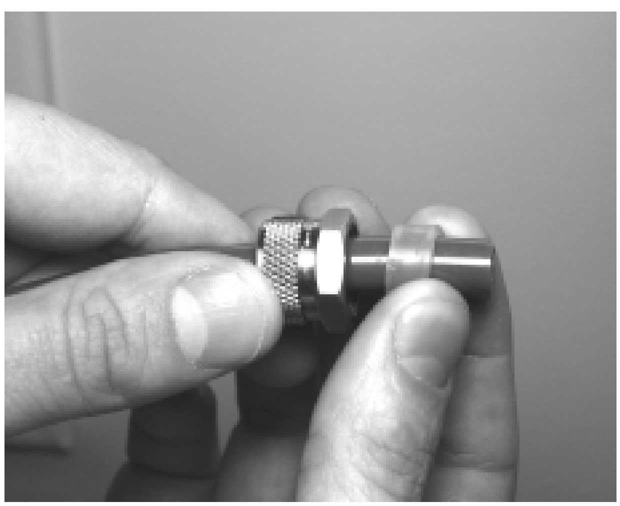


Figure K-101. Installing the bypass extension and rubber ring onto the green bypass tubing.

35) Install the rubber ring onto the end of the green bypass tubing (Figure K-101). Ensure that the rubber ring is approximately 1/4-inch from the end of the green bypass tubing.

36) Insert the green bypass tubing into the bypass extension (Figure K-102).

Figure K-102. Installing the green bypass tubing onto the bypass extension.

37) Tighten the bypass extension fastening nut onto the bypass extension (Figure K-103).

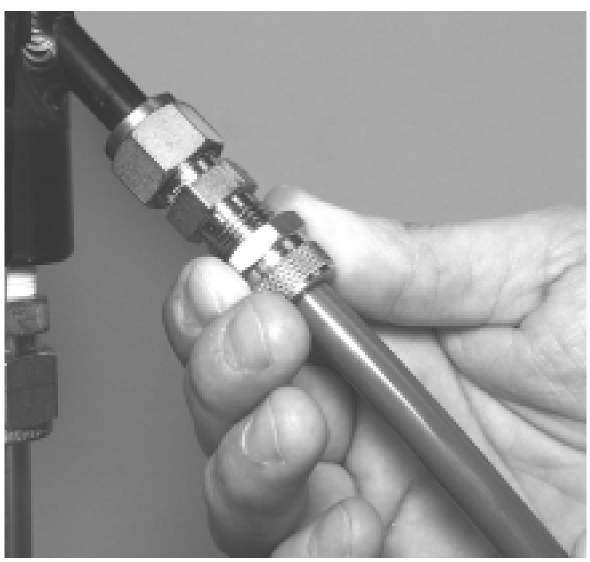


Figure K-103. Tightening the fastening nut onto the bypass extension.

38) Secure the control unit to the rack angle uprights (Figure K-67).

39) Go to Section K.6. (Circulating Fan Installation).

K.6. Circulating Fan Installation

The outdoor enclosure includes a circulating fan kit containing the necessary hardware to install the fan. The kit includes:

Circulating fan
Mounting bracket
3 1/4 x 20, 5/8-inch machine head screws with nuts
Tubing bracket
Adapter
1 1/2-inch green tubing
4 10 x 32, 3/4-inch machine screws with nuts
2 10 x 32, 3/8-inch machine screws

Follow these steps to install the circulating fan:

1) Locate the fan assembly and mounting bracket (Figures K-104 and K-105).

Figure K-104. Fan assembly.

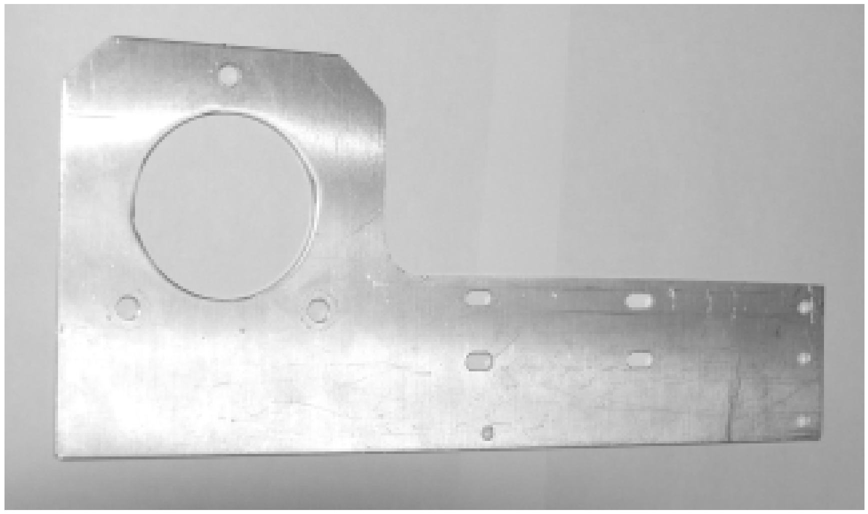


Figure K-105. Mounting bracket.

2) **Install the mounting bracket onto the 1 1/2-inch tubing outlet (Figure K-104) of the fan assembly with the three 1/4 x 20, 5/8-inch machine screws with nuts (Figure K-106).**

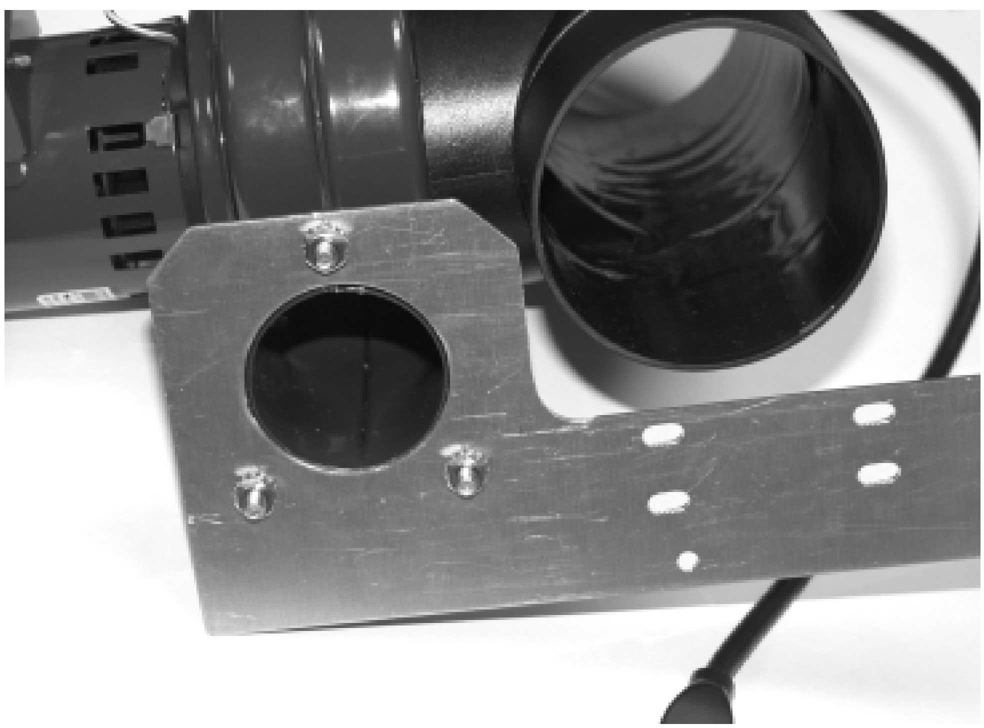


Figure K-106. Mounting plate installed onto the 1 1/2-inch tubing outlet of the fan assembly.

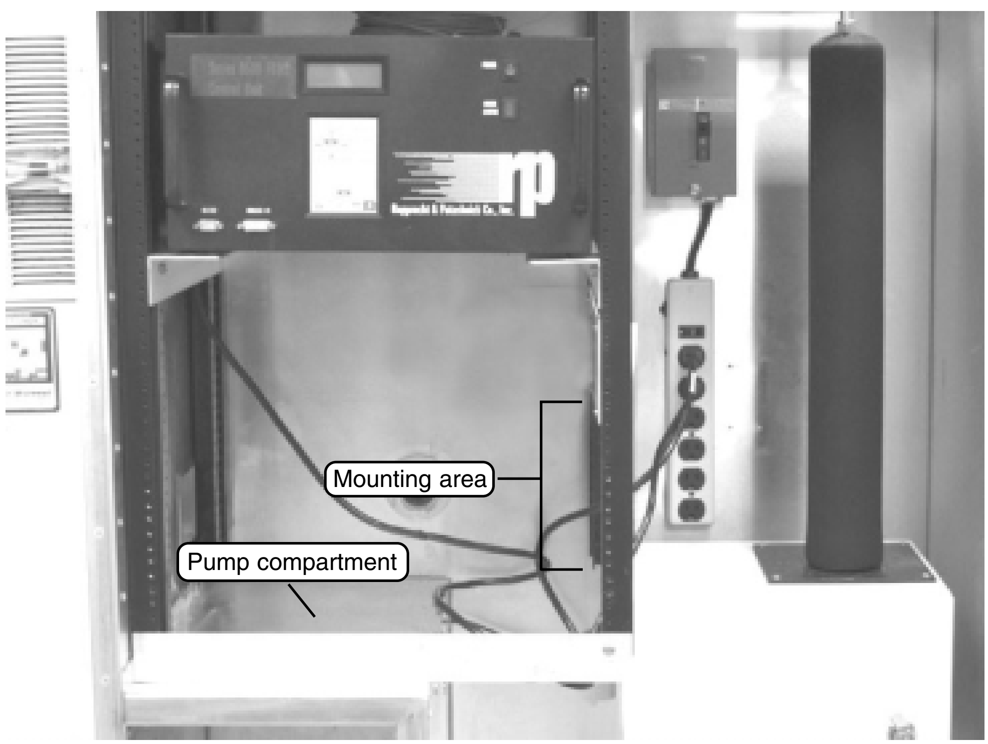
3) Locate two of the 10 x 32 machine screws and nuts.

NOTE: New enclosure rack mounts have threaded holes for 3/8-inch, 10 x 32 screws. Other enclosure rack mounts have drilled, 1/4-inch holes. For these installations, use two 10 x 32, 3/4-inch machine screws and nuts. Two additional 10 x 32, 3/4-inch machine screws and nuts are included if a special need arises. If you have an older model enclosure that has plain angle supports (no holes), you must drill holes in the plain angle supports. Be sure to contact R&P before drilling holes in the plain angle supports.

4) Select where inside the enclosure you would like to mount the fan assembly (Figure K-107).

NOTE: Mounting the fan assembly as low as possible on the back, right-hand rack mount helps maximize additional space in the enclosure. However, some enclosures have a heater assembly mounted at the top or top, right-hand corner of the pump compartment (Figure K-107). You also may have to adjust the location of the fan to make room for a data logger or other equipment installed in the enclosure. In these cases, the new fan assembly may have to be mounted higher on the rack mount to be clear of the heater assembly, data logger or other equipment.

Figure K-107. Mounting area for fan assembly.



5) Line up the holes in the mounting bracket with the holes in the back, right-hand rack mount (Figures K-108, K-109 and K-110).

Figure K-108. Installing fan assembly into enclosure.

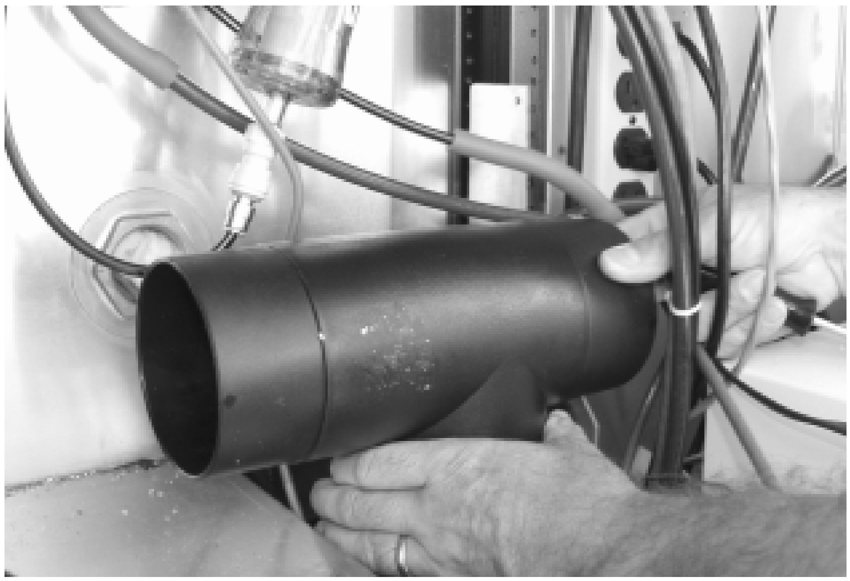


Figure K-109. Mounting bracket hole lined up with hole in rack mount.

NOTE: There are three sets of holes in the bracket (Figure K-110). Use the holes/slots on the edge closest to the 1 1/2-inch tubing outlet unless the heater or other equipment interferes, in which case the middle holes/slots may be used. The single holes at the outside edge of the bracket are for enclosures that require drilling.

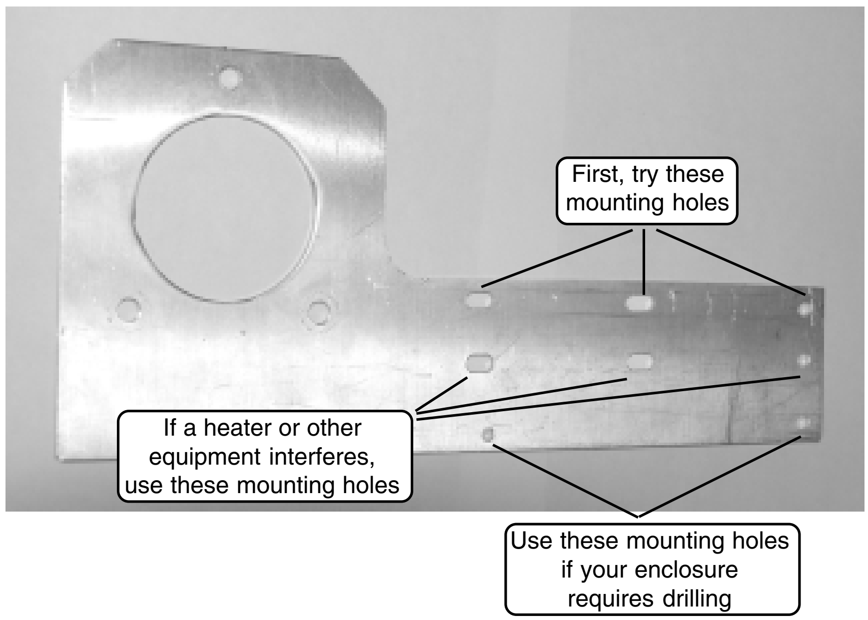
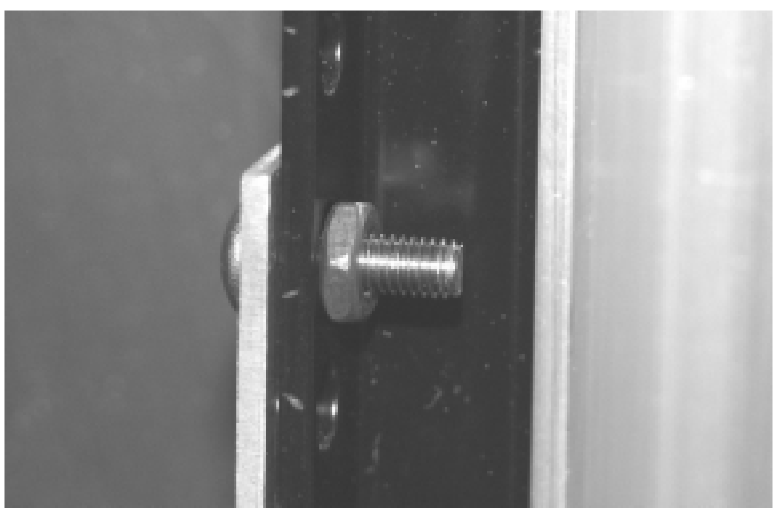


Figure K-110. Screw holes in bracket.

6) Install the two 10 x 32 machine screws into the holes in the mounting bracket (Figure K-111) and install the nuts, if necessary (Figure K-112).

Figure K-111. Installing 10 x 32 machine screw through mounting bracket and rack mount.

Figure K-112. Close-up view of nut installed on screw.



7) Locate the 18-inch (46 cm) length of 4-inch, black, plastic flexible tubing with two hose clamps.

8) Install the open end of the 4-inch, black, plastic flexible tubing onto the large plastic T-fitting on the fan assembly (Figures K-113 and K-114).

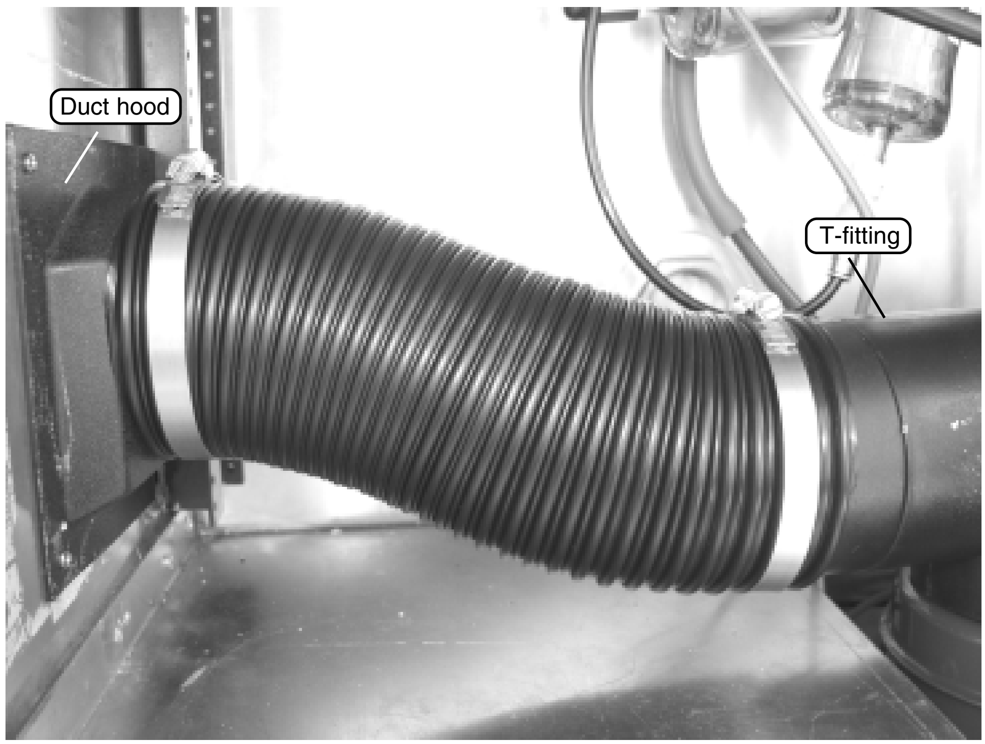


Figure K-113. Black plastic tubing installed on duct hood and T-fitting.

9) Tighten the hose clamp to secure the black plastic tubing (Figures K-113, K-114 and K-115).

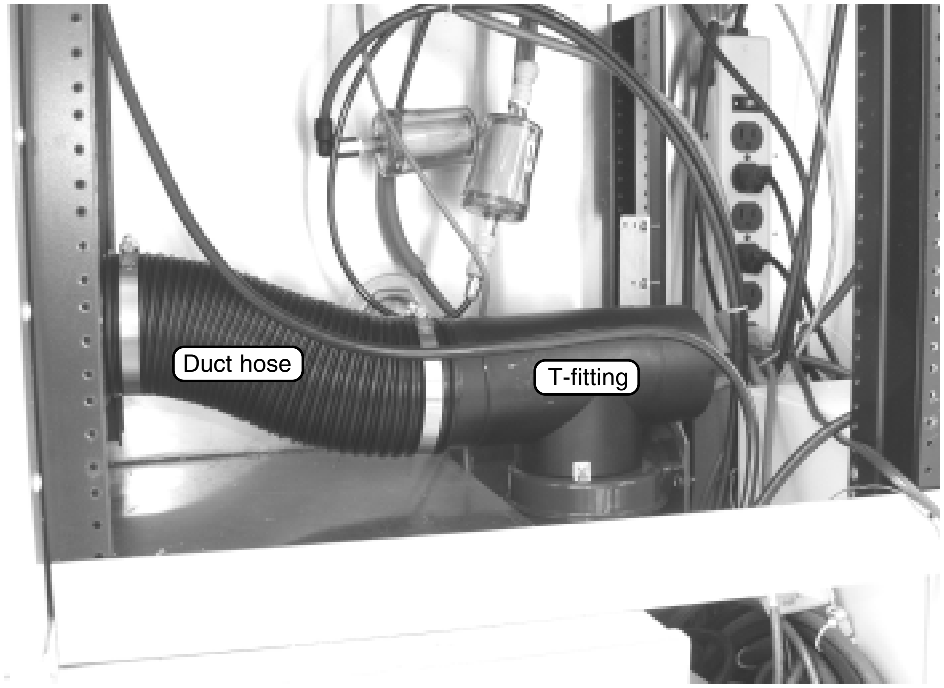


Figure K-114. Fan assembly installed in the standard position.

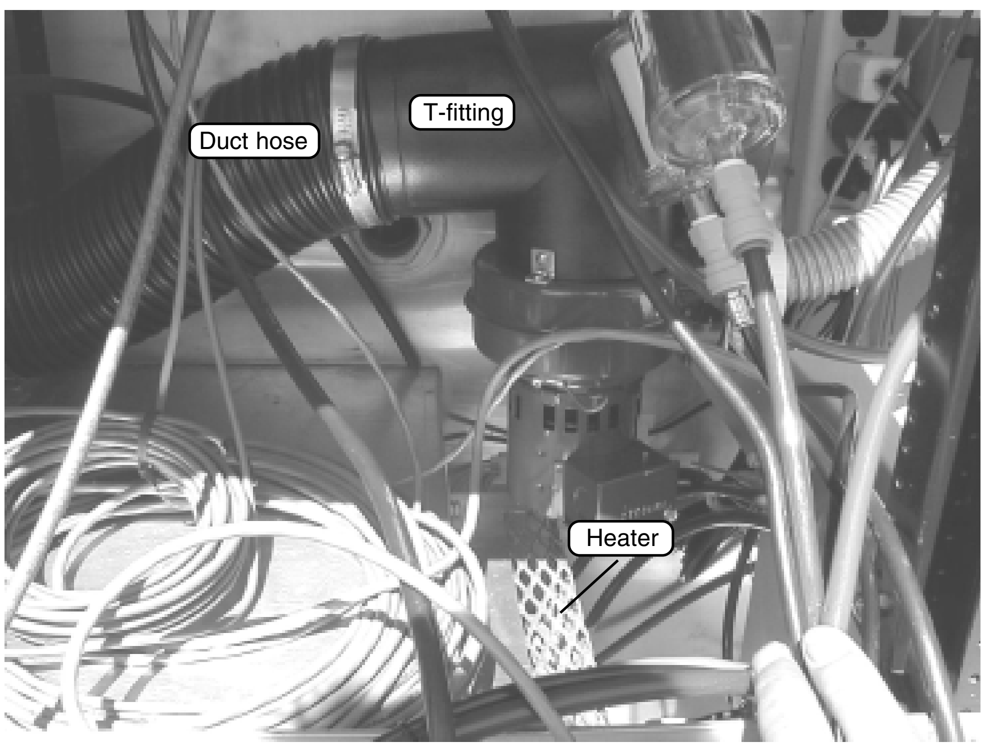


Figure K-115. Fan assembly installed in a higher position to avoid blocking the heater.

10) Locate the 3-foot length of 1 1/2-inch green tubing and adapter. Install the tubing into the adapter (Figure K-116).

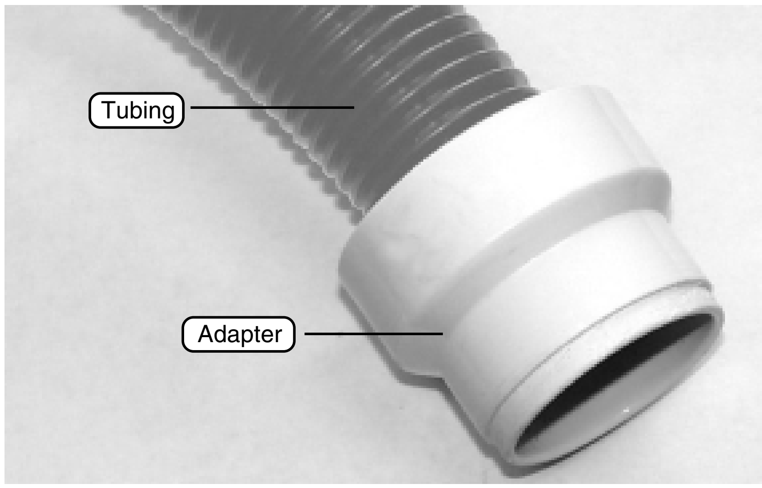


Figure K-116. Tubing installed in adapter.

11) Install the tubing and adapter into the 1 1/2-inch tubing outlet of the fan assembly (Figure K-117).

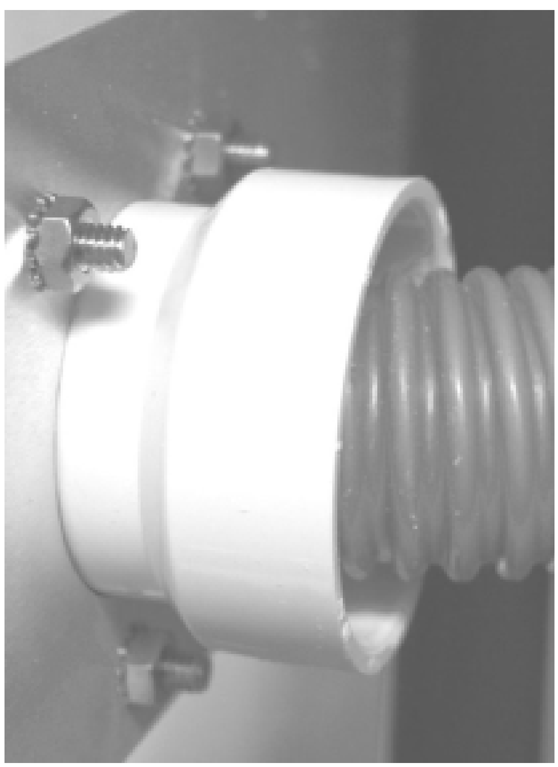


Figure K-117. Adapter and tubing installed into the 1 1/2-inch tubing outlet of the new fan assembly.

12) Install the other end of the 1 1/2-inch green tubing through the bracket in the enclosure roof (Figure K-118) and up into the 8500 module enclosure.

NOTE: Ensure that the green tubing is installed two-thirds of the way up into the 8500 module enclosure (Figure K-119).

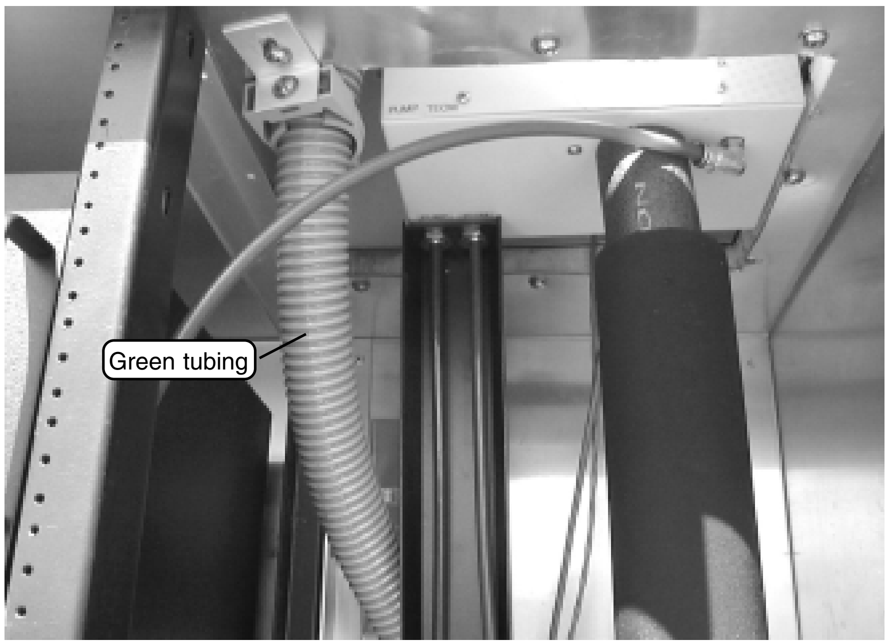


Figure K-118. Green tubing installed through the bracket in the roof of the enclosure.

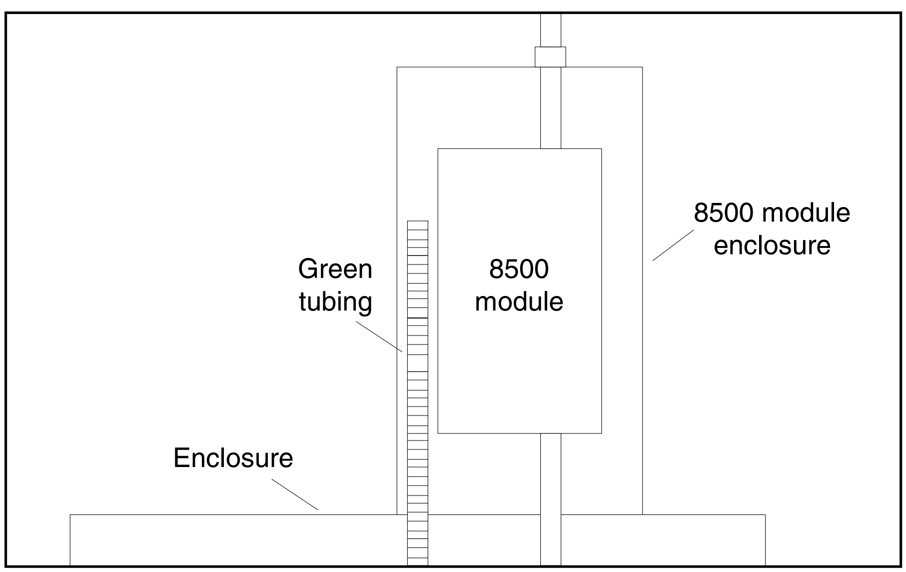


Figure K-119. Green tubing installed two-thirds of the way up into the 8500 module enclosure.

K.7. Outdoor Enclosure Maintenance

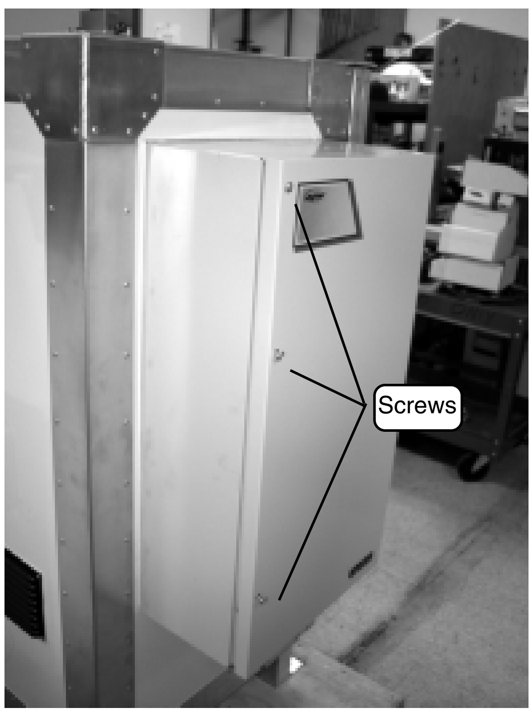
K.7.1. Adjusting the Temperature Setting

On the outdoor enclosure, temperature settings are preset: the climate control system is set to 60° F (16° C). This setting can be adjusted, if necessary. The temperature controls are located on the thermostat inside the control box.

Follow these steps to locate the outdoor enclosure's control board:

1) **Disconnect the air conditioner/heater power cord from its power source.**
2) **Locate the air conditioner/heater cover for the outdoor enclosure (Figure K-120).**

Figure K-120. Air conditioner/heater cover for the outdoor enclosure.



3) **Locate and remove the screws from the cover (Figure K-120).**

4) **Open the cover (Figure K-121).**

Figure K-121. Air conditioner/heater with cover open.

5) **Locate the thermostat at the top of the enclosure (Figure K-121).**

6) Turn the black dial to set the thermostat to 70° F (Figure K-122).

Figure K-122. Thermostat set to correct temperature.

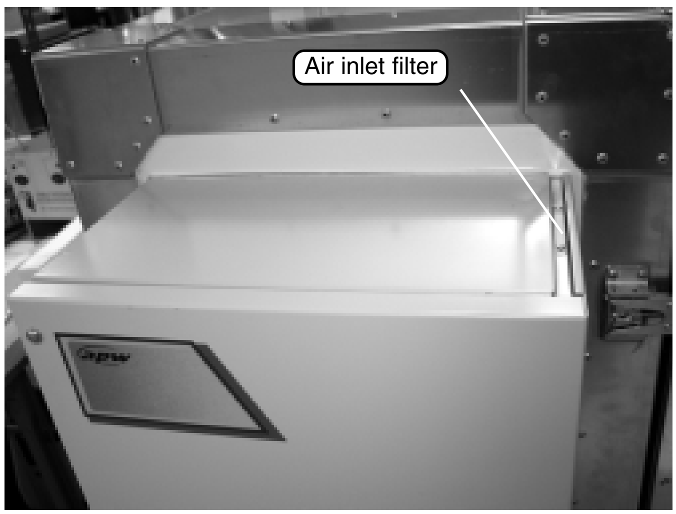
K.7.2. Cleaning the Air Inlet Filter

The air conditioner is designed to be maintenance-free, with the exception of the condenser air inlet filter. You must periodically clean the air conditioner/heater air inlet filter. Check the air inlet filter monthly, and clean it as necessary. Also, you must periodically clean the screen that is located on the back of the pump box.

Follow these steps to clean the air inlet filter:

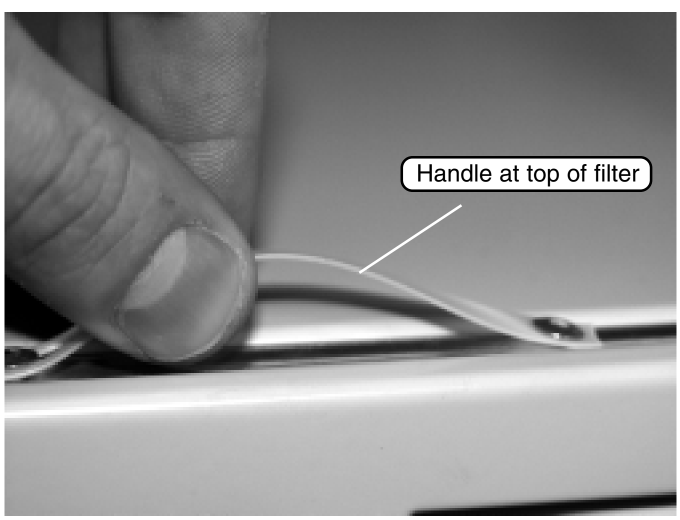
1) Locate the air inlet filter on the top, right-hand side of the air conditioner/heater enclosure (Figure K-125).

Figure K-123. Top of the enclosure.



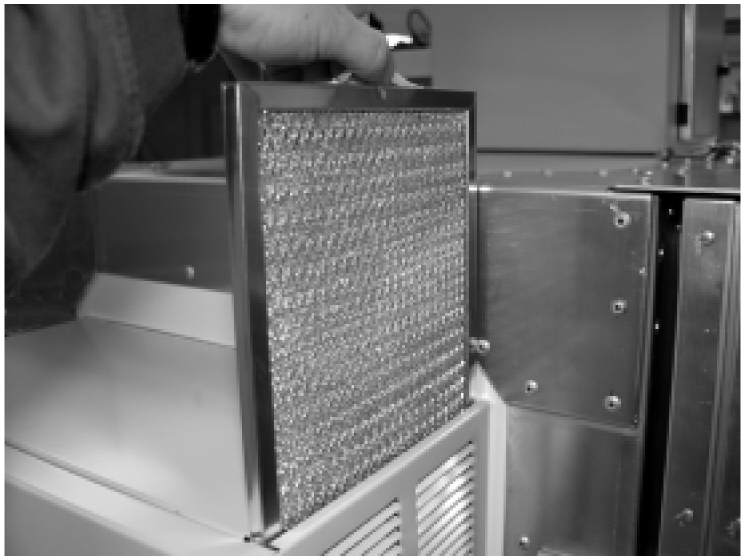
2) Locate the handle on the top of the air inlet filter (Figure K-125).

Figure K-124. Close-up view of the top of the air inlet filter.



3) Pull the filter up and out of the enclosure (Figures K-126 and K-127).

Figure K-125. Removing filter



4) Clean the filter by flushing it with warm water.

5) Allow the filter to dry thoroughly.

6) Recoat the filter with McLean Midwest RP Super Filter Coat adhesive (22-002678), or an equivalent adhesive. If the air inlet filter is damaged, you can purchase a new filter from R&P.

7) Install the cleaned (or new) filter into the air conditioner/heater enclosure.

K.7.3. Cleaning the Condenser Coils

You must clean the air conditioner's condenser coils as needed.

Remove the cover of the air conditioner/heater (Figure K-123). Clean the front and back of the condenser coils (Figures K-123 and K-124) with a brush or compressed air.

Figure K-126. Air conditioner/heater with cover removed.

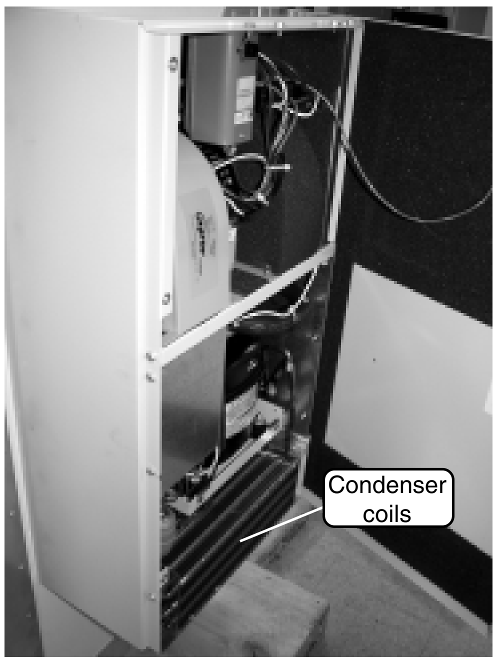
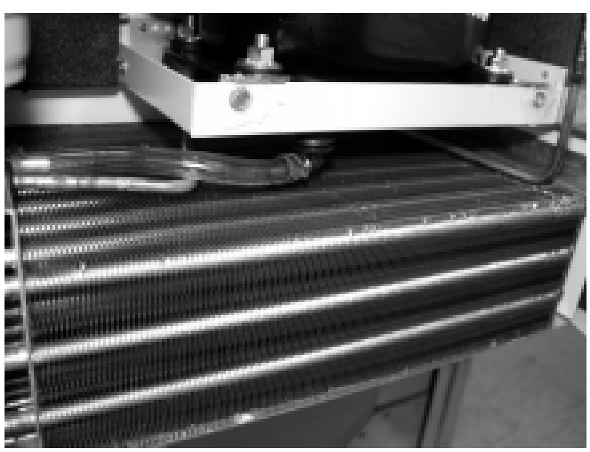


Figure K-127. Close-up view of the condenser coils.



K.8. Installing the Optional Sliding Shelf

Locate the following parts to install the sliding shelf:

Sliding shelf
4 #10-32 screws
4 #10 star lock washers

Follow these steps to mount the sliding shelf :

1) **Unpack the shelf and place it on a flat surface. Note that the shelf is mounted upside down, so that the front and rear lip of each shelf points upward.**
2) **Completely extend one of the shelf slides.**
3) **Locate the black lever at the end of the shelf slide, near the shelf. Pull the lever and pull the shelf slide off the shelf.**
4) **Repeat steps 2 and 3 for the other shelf slide.**
5) **Examine the mounting rails in the outdoor enclosure. Remove the existing mounting shelf, if necessary.**
6) **Place the left shelf slide in the correct position on the mounting rails.**
7) **Secure the back of the slide using a #10-32 screw and #10 star lock washer. The slide mounting hole used in the back is centered on the slide and lies in the middle of a U-shaped slot. The position of the slide can be adjusted to get access to the mounting hole.**
8) **Secure the front of the shelf slide to the mounting rail using a #10-32 screw and #10 star lock washer. The slide mounting hole used in the front is slotted. The position of the slide can be adjusted to gain access to the mounting hole.**
9) **Repeat steps 6-8 to install the other shelf slide.**
10) **Align the shelf on the shelf slides and push it into the enclosure. The shelf will snap into place. Ensure that the shelf is mounted upside down, so that the front and rear lip of each shelf points upward.**

K.9. 8500 Module Enclosure Access Points

The Revision C 8500 outdoor enclosure gives users access to the revision C 8500 module through a door in the side of the enclosure and a panel in the back of the enclosure.

The door on the side of the outdoor enclosure (Figure K-128) allows access to the door in the Revision C 8500 module, which is used for 47 mm filter installation and removal (Section 3.2).

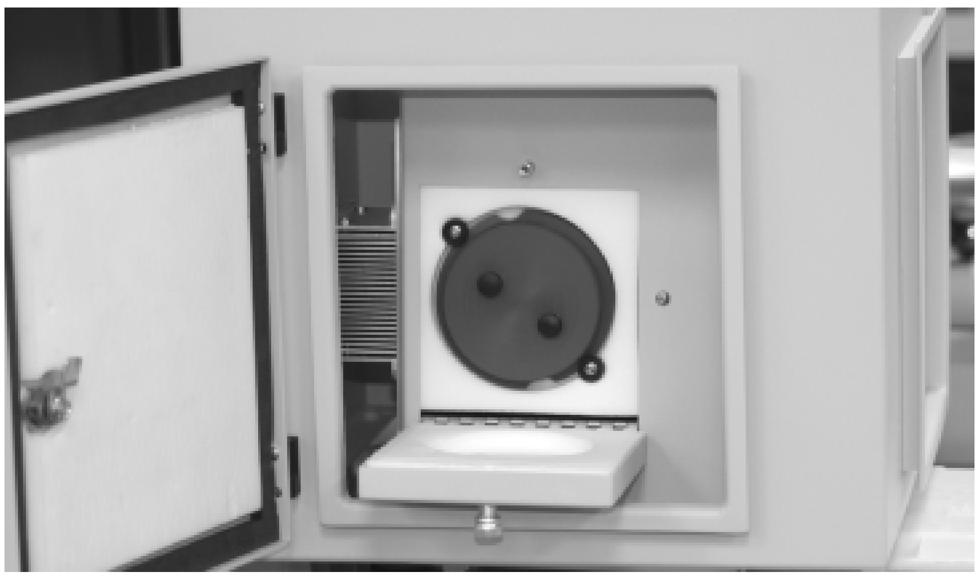


Figure K-128. Revision C 8500 outdoor enclosure with side door open to expose the door in the Revision C 8500 module.

The panel on the back of the 8500 outdoor enclosure (Figure K-129), attached with 12 screws, allows you to remove the 8500 module access panel (Figure K-130). Also, you can reach the electrical connections and the power switch of the 8500 module by removing the back panel of the 8500 module enclosure.

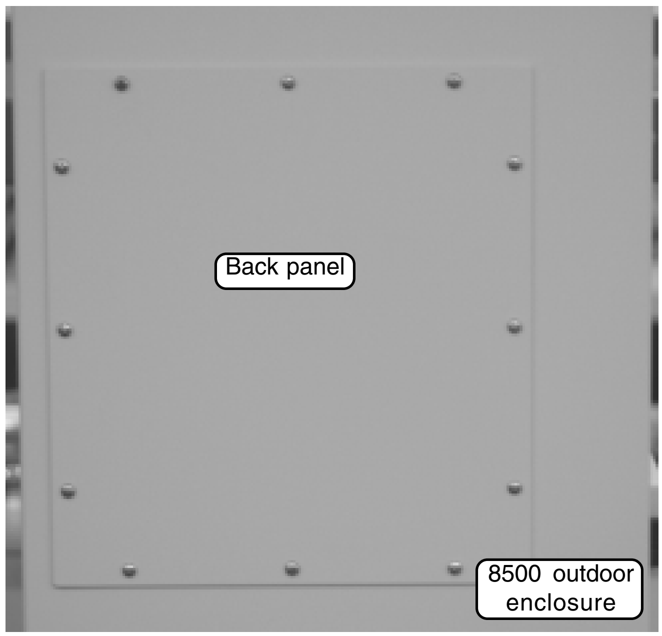


Figure K-129. 8500 module outdoor enclosure with back panel installed.

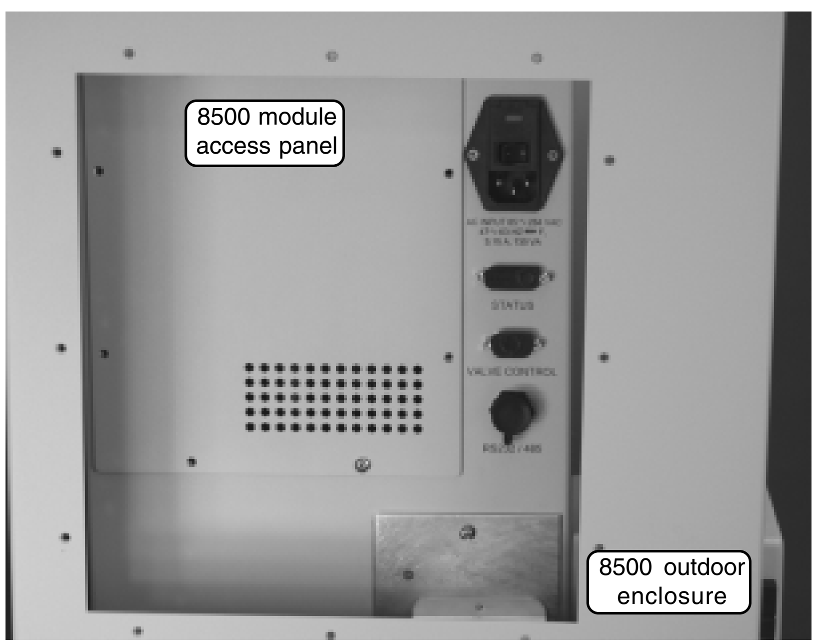


Figure K-130. 8500 module outdoor enclosure with back panel removed.

Appendix L: Series 8500 Schematics

This section contains schematic diagrams and interconnect diagrams of the major electronic components in the Series 8500 Filter Dynamics Measurement System. Schematic diagrams for the industrial microcomputer system are not included here because they are proprietary to the manufacturers of these boards. Refer to the Series 1400 Service Manual for diagrams of the control and sensor unit.

Electrical Schematics

Schematic Description	**Schematic Part Number**	**Schematic Revision**
Interconnect Diagram	81-010880	A

Rev	Page/Zone	Revision Description	Date	ECN#	App'd
A		Initial Release			

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Date 06/02/06
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Date
ENGR
Date
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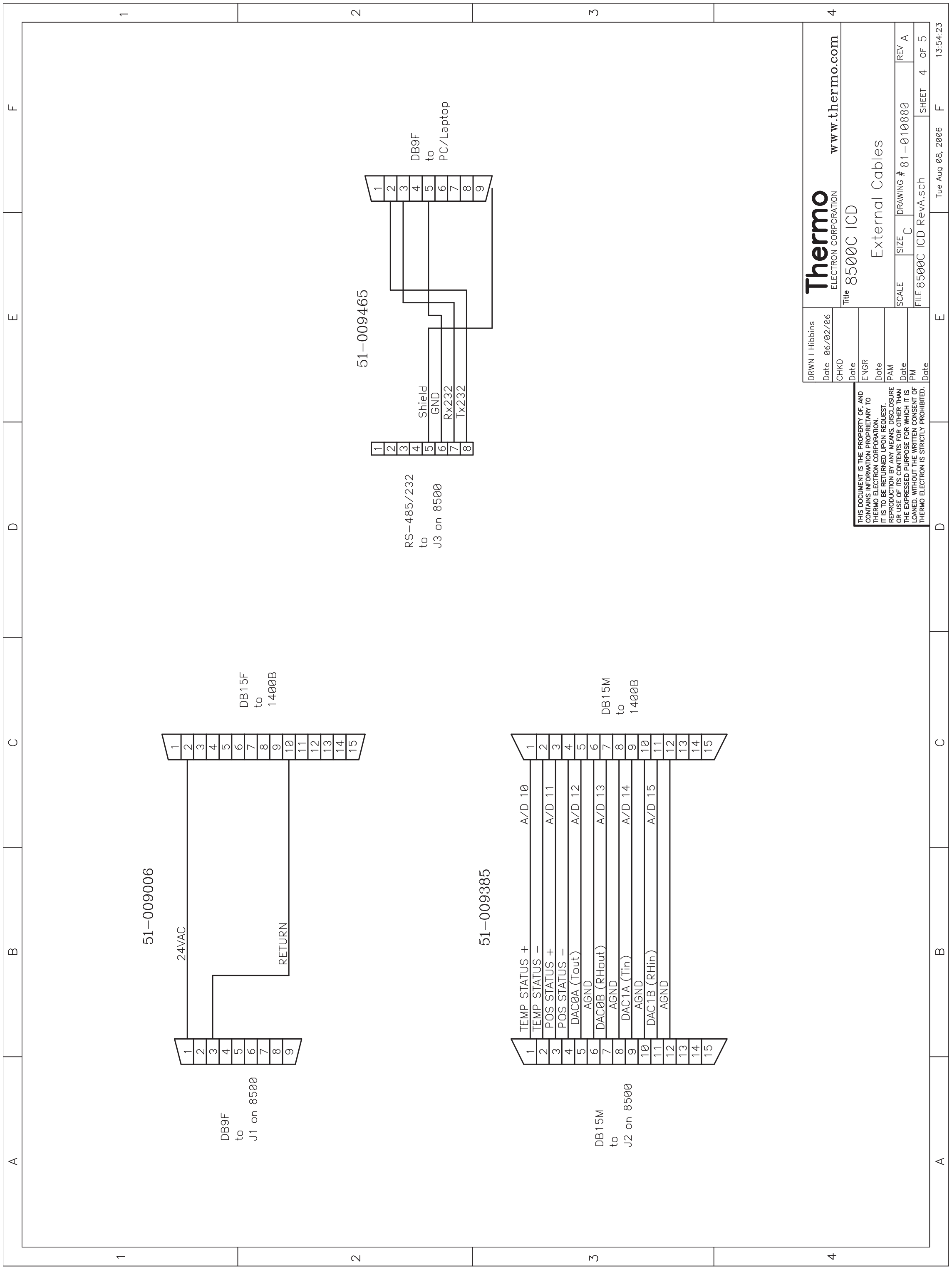
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Tx232
RS-485/232
to
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24VAC
RETURN
DB15F
to
1400B
DB9F
to
J1 on 8500
51-009385
DB15M
to
1400B
A/D 10
A/D 11
A/D 12
A/D 13
A/D 14
A/D 15
TEMP STATUS +
TEMP STATUS -
POS STATUS +
POS STATUS -
DAC0A (Tout)
AGND
DAC0B (RHout)
AGND
DAC1A (Tin)
AGND
DAC1B (RHin)
AGND
DB15M
to
J2 on 8500
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Date 06/02/06
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ENGR
PAM
PM
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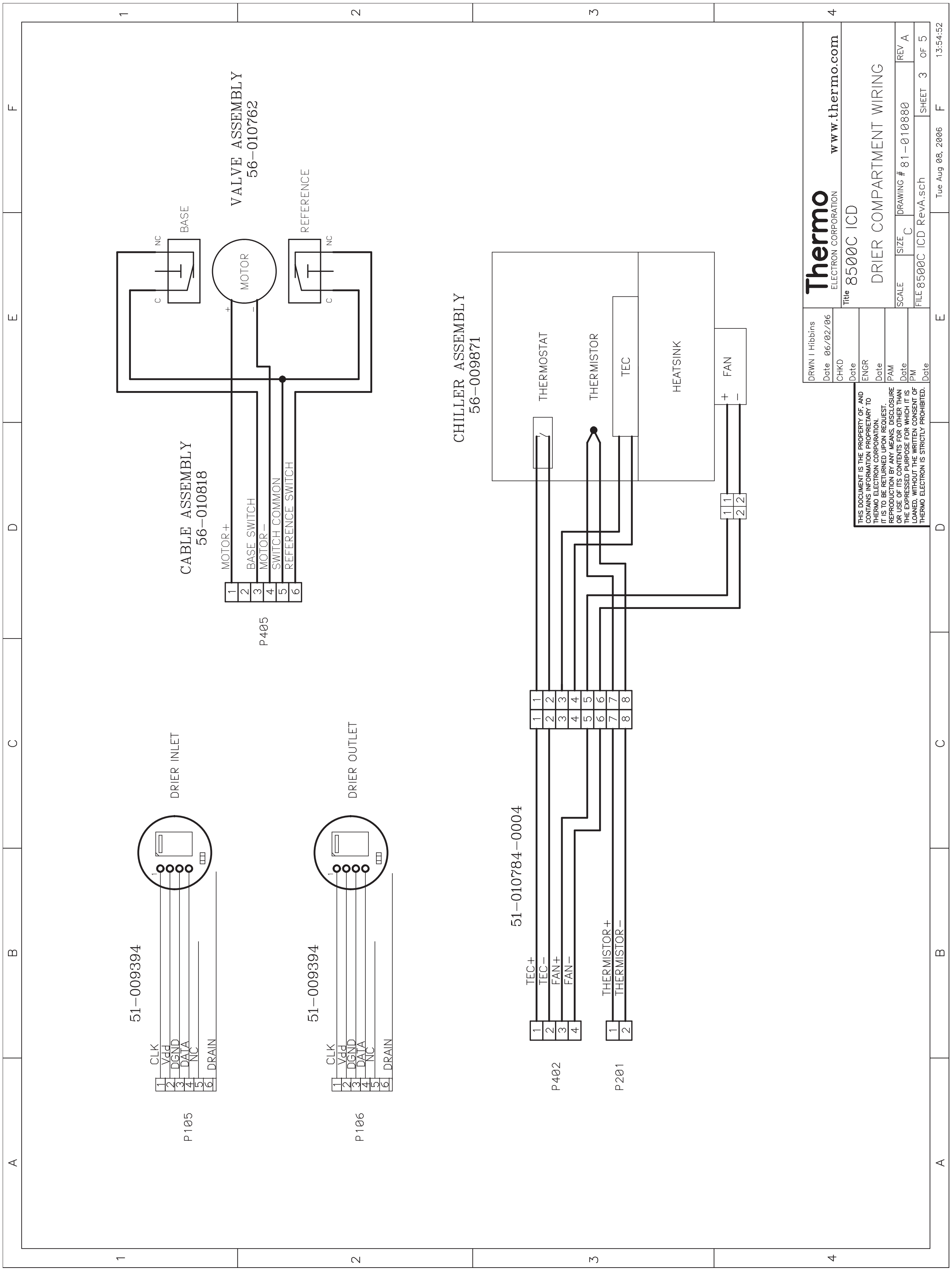
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CHILLER ASSEMBLY
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THERMISTOR
TEC
HEATSINK
FAN
DRIER INLET
DRIER OUTLET
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P106
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TEC-
FAN+
FAN-
THERMISTOR+
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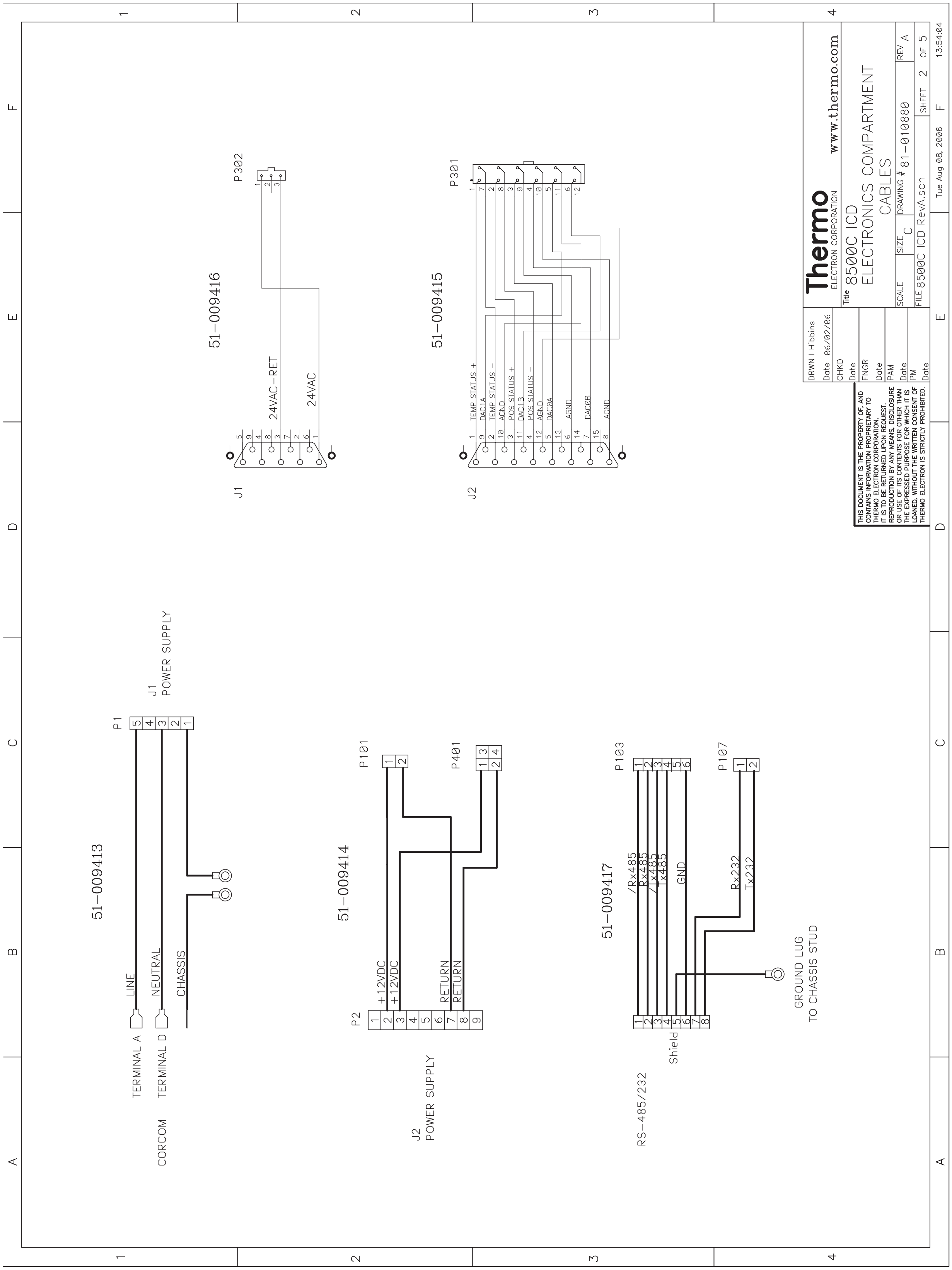
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DAC0A
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DAC0B
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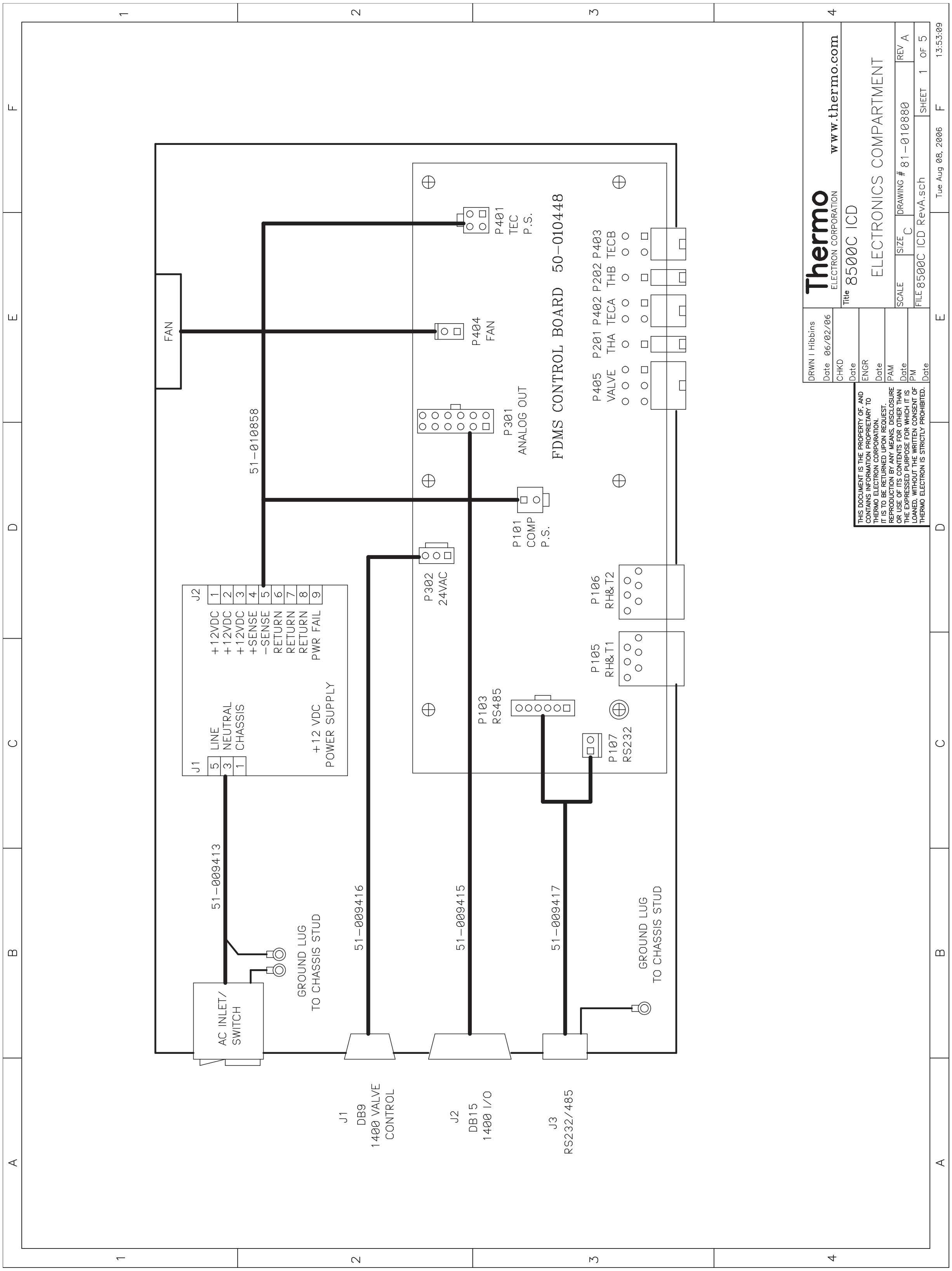
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P.S.
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P106
RH&T2
P105
RH&T1
P103
RS485
P107
RS232
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AC INLET/
SWITCH
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DB9
1400 VALVE
CONTROL
J2
DB15
1400 I/O
J3
RS232/485
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